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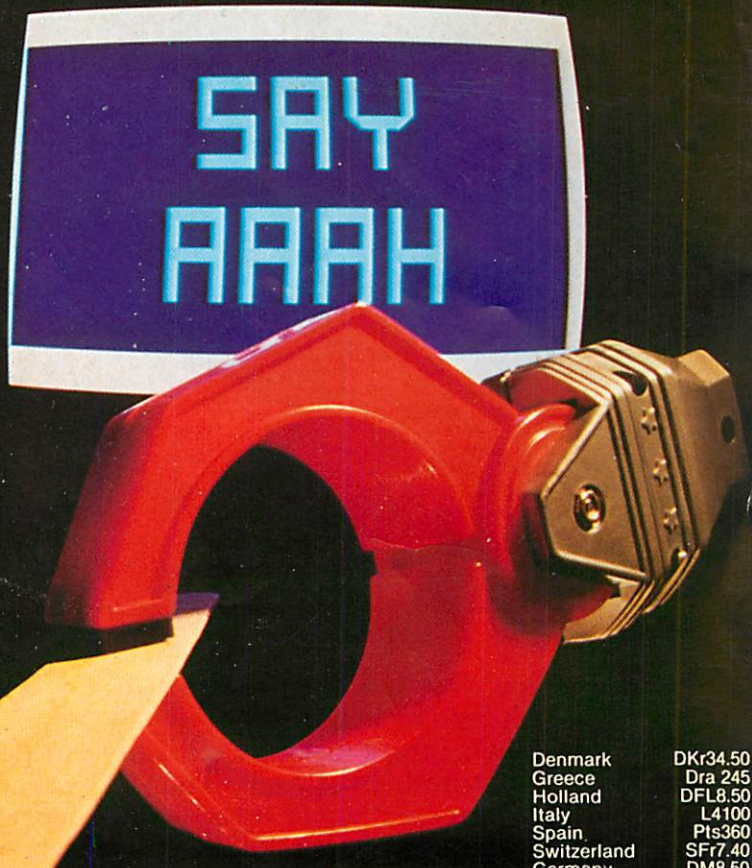

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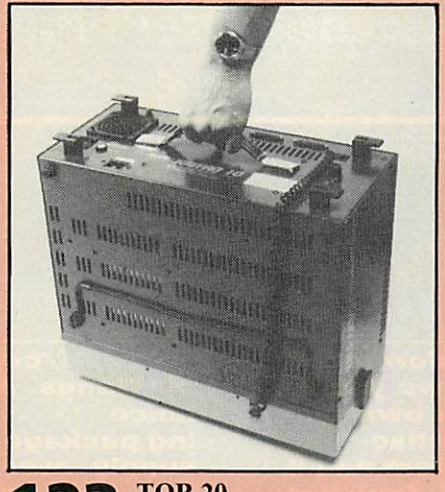

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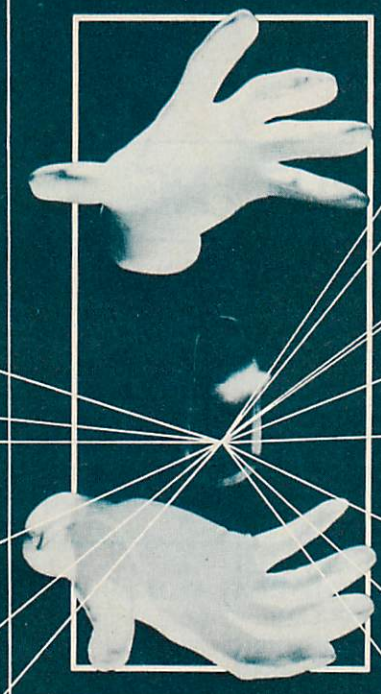

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Every effort is made to check articles and listings but *PC* cannot guarantee that programs will run and can accept no responsibility for any errors.

Boom-bust

TAKE A revolutionary new product that over a mere seven years will change the lives of two-thirds of the country's population. The product is highly portable, production costs are lower than anywhere else and the quality is higher. You know that sales will increase by over 10,000 percent in seven years, then spread over two-thirds of the entire world. Would you invest in it?

No, this is not the microcomputer. This is America in 1946, it's the television set, and the figures are for sales up to 1953.

According to Norman Macrae in *The Economist* magazine, the number of firms making TVs in America quadrupled. But "even in the boom years, less than half of the American firms sometime operating in this healthy market ever showed a really healthy positive cash flow, and in the five years after 1953 more than three-quarters closed down, increasingly on terms equivalent to going bust."

There are innumerable other examples. Macrae quotes the correct forecasts for 1952 to 1982 of passenger miles flown in airlines increasing by 3,200 percent and that by 1982 all the biggest airlines would be going bust.

In the middle of last year, *Practical Computing* in its Fifth Birthday Editorial was sounding a warning note. "This is the microcomputer boom. After the boom comes bust."

It is extremely unlikely that anyone took the warning seriously. Yet within a few months companies began to go into receivership with increasing frequency, and in America sought protection from creditors under the Chapter 11 law. The list includes Osborne, Computer Devices, HH, Almarc, Digico, Grundy Business Systems, Victor, Information Technology and Computer Services, and many more. Other companies have secured injections of cash, including Dragon, Torch, Oric and Camputers.

Two major companies, Texas Instruments and Mattel, have been forced out of the home-computer market by massive losses. Several companies have made smaller losses. Vector Graphic is having problems. Corvus is moving into loss and Apple's fourth-quarter profits crashed. In 1983/4, Atari is set to lose over $500 million.

All the firms mentioned, and their products, may survive and prosper. Osborne is still trading successfully, the Newbrain lives on in Holland, Almarc has been purchased as a going concern — and so on. But the severity of the situation was made clear by Apple's recent annual report which said that "At one point in 1983, the combined losses in the home computer segment of the market exceeded the profits being earned in the total industry." In 1983, for the first time the microcomputer industry went into loss.

Some companies will still makes lots of money out of micros. Sinclair, for example, could easily sell a million QLs. Orders could already run to 100,000 machines worth £40 million. But it is unlikely that the industry as a whole will make a worthwhile profit for some years now. It is a sobering thought.

In our own field, while *Practical Computing* has shown a profit this financial year, we suspect that the business of publishing microcomputer magazines is already running heavily into loss. Companies are supposedly investing in the future by desperately throwing magazines at the bookstalls. As we know, most will survive for a couple of years, because there are always mugs who will buy them and their hard-sell advertising space. But when the real shake-out comes they will disappear, having lost their publishers a considerable amount of money in the meantime. Another sobering thought.

If it is any consolation, the successes will be worthwhile. A lot of small companies will do very well, just as today small airlines are prospering as never before. It is encouraging too that a small company like Microvitec can make a better colour monitor than the mighty IBM, can make it in Bradford, and can sell it cheaper than IBM.

But the microcomputer industry is now pretty much on a par with slot-machines in Las Vegas, with one difference. In the micro industry far more money is at risk. Just hope none of it is your pension fund.

5 Years ago...

"I sold my HP calculator and Steve sold his van and we used the money to hire a printed circuit artist to lay out the boards. While we were thinking about making the first boards, Steve received a telephone call to place a $25,000 order for 50 complete computers, fully built. We were planning to sell only blank boards but these were orders for boards which were fully stocked with the ICs.

"The order was from the local Byte Shop. By arranging credit properly we were able to get all the components we needed to build the boards. Then we went and sold them on the date for which the purchase order was made out and were able to pay our creditors. It was a very neat operation. We were able to turn the whole thing around very fast, in less than a month. That put us in business — in a garage.

"We decided to call the company Apple. Steve was working at a place called Apple Orchard, or something like that, in Oregon. It's a really great name — it's one of those names which sticks.

"We used the garage for a year and we didn't move too many computers, about 200; but it was the name which sold, and we started advertising in the magazines."

Steve Wosniak
Interviewed in *PC* Volume 2 Issue 4

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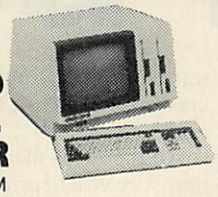

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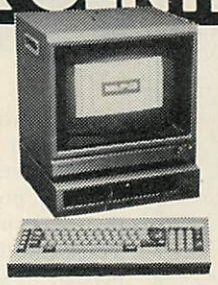

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War games

OLIVER VOLCKERS' remarks on computer war games — *PC*, February, page 7 — deserve wider currency. The editorial comment suggests three possible considerations:

1. computer war games may be bracketed with chess, and hence share its social responsibility
2. computer war games may be historically accurate
3. computer war games may be educational.

To describe chess as a war game is really stretching semantics to the extreme. Chess is an abstract, intellectual game, played according to strict and fixed rules. To attempt to describe it in the vocabulary of conflict as a war game is at worst dishonest and at best merely trite.

Mere historical accuracy is not of itself a justification for the marketing of programs or games that attempt to simulate the death or torture of other people. Would historical accuracy alone justify games along the lines of ". . . you are leader of a group of militiamen in Beirut, and your task is to break into the refugee camps and machine-gun to death as many men, women and children as you can . . ." or ". . . how many Jews can you gas before the Allies arrive (bonus points for gold fillings) . . ."?

Such computer nasties are not so far away. Yet historically accurate games simulating the killing of other people are not qualitatively different from these. In any case, historical accuracy is not a particularly important attribute of role-play war games where the player is not confined greatly by the original situation being modelled.

The concept of situation modelling is important in relation to arguments that war games can have an educational value. A model of any situation is an abstraction of certain elements of what is being modelled. The first thing to be realised by any competent computer scientist is the grave limitations imposed on a model by the abstraction process, and the almost grievous consequences of significant deviations from these limitations. Ignorance of the limitations of a model may not mean much to a war-game role player, but it makes nonsense of any educational value. Nor is the player's involvement a passive one; it is an active involvement in and reinforcement of the ethos of killing.

It may be argued that computer war games can inculcate a sense of revulsion in the player, or that clearing graphic blobs from a TV screen is too distant from the real world. Nevertheless such games do not sell on the basis of teaching revulsion of war, but allow the sensation of killing to be experienced at considerable psychological distance from the objects of the killing, a factor described by Jo Weizenbaum as the "psychic numbing" required to make ordinary people do horrible things to ordinary people.

It is no accident that the U.S. Army has reportedly installed video machines so that soldiers may play war games supplied by a well known computer games organisation. This is happening in a world where Mr Reagan has stated that "the Space Invader playing kids of today will be the fighter and bomber pilots of tomorrow". In real high-tech warfare, where the enemy may well only be seen as graphic blobs on a TV screen, the notion of the computer war game may not seem too far removed from the real world after all.

Alex Macphee,
Edinburgh.

I WONDER whether Mr Völckers is pulling your leg? The object of Eastern Front is not to plan the death of men most effectively. The object is to understand what happened — note the tense, this is history — and hope to understand better why it happened.

If children stand any chance of believing war is fun as a result of playing the game, then TV and the elaborate reaction timers called arcade games will already have turned them into psychotics.

Bill Radcliffe,
Teddington,
Middlesex.

YOU ARE WRONG. Chess is not a war game, any more than bridge or cribbage are. As for war games, yes they are harmful — especially to people of poor character and inadequate imagination. They instil a dangerous ability to depersonalise death, destruction and the "enemy". They are extended in wartime by deliberate phrases like Gooks, Reds, the Hun, who can be "wiped away" or "liquidated".

On the other hand, I know several people who played with toy soldiers as children and became pacifists. But I suspect they were more sensitive than most.

If this is true, war games are a means of brutalising people in the guise of entertainment for the profit of a few. Therefore they are to be opposed, like video nasties. Both induce laziness too! But minorities copy them to commit some crimes.

A Kennaway,
Ashtead,
Surrey.

FOR SOME time now we have been concerned about the warlike nature of most computer games. War is horrible, and using it as a basis for games must influence the player's mind to an acceptance of death and destruction.

There is a growing number of people who are searching for games that are not warlike. We know of some such games but feel that there are many more. Our group is working towards the publication of a list of non-warlike games. We would be glad to receive suggestions of games suitable for inclusion.

James Hough,
Microtechnology Group,
Quaker Social Responsibility and Education,
Friends House,
Euston Road,
London NW1 2BJ

● **The editor replies:**

1. Surely most games are war games in the sense that the player tries to occupy the opponent's territory, often remove his players, or pieces, or counters, or armies, and convert supremacy into victory. Backgammon and Go are two examples. The board game Risk is a classic in this genre. Chess is about the death of enemy pawns and the capture of the enemy warlord, isn't it? The only difference is the level of abstraction. In Eastern Front, the object of the game is to move your little white squares as far to the right of the board as possible, though in the game this is put in historical context. Why is this harmful?
2. At first sight the argument has nothing to do with video games, insofar as the principle is the same with board games, etc. However, when human plays computer, human is most likely to lose. It seems more significant that in most video games the human players are faced with ultimate defeat, no matter how heroically they battle against overwhelming odds. Space Invaders, Defender, Missile Command and Gorf are examples; Eastern Front is another. Computers are already better than humans at Backgammon and Go, and better than 98 percent of humans at chess. Are we being conditioned to lose, and how will this affect society?

Pi-mania

NO, nobody can give Mr Mehew — see Feedback, *PC*, October 1983 — a precise value for π. Such a thing does not exist, and

(continued on next page)

Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback — it is your chance to keep in touch.

(continued from previous page)
this is the implicit in Mr Chugg's reply, January 1984, when he gave the infinite series for π. The number π is transcendental, it cannot be expressed as a fraction, and does not recur or terminate when expressed as a decimal. All values obtainable are therefore approximations of differing degrees of accuracy.

Various fractions or expressions used to give an approximation may be put further in error by the method that the computer uses to evaluate them. The most reliable method would seem to be to enter the required value directly, stored as a variable if necessary. It is quite easy to keep a reference note of a value to a much higher degree of precision than will be needed, and enter the number of correct significant figures when wanted.

I keep a record of the value correct to 15 significant figures:

3.14159265358979

which if used in any calculation would give an error of less than 4cm. in a light-year. As an engineer I am not really interested in such precision, and in the cold hard world of cost-effective compromises six significant figures give all the accuracy that anyone is normally prepared to pay for.

A Jackson,
Pollenca,
Mallorca,
Spain.

Nascom lives!

I READ in the "5 Years Ago" spot on page 5 of the December issue of the delivery of your first Nascom 1.

You may be interested to know that the Nascom 1 is still available in kit form for immediate delivery at £49.95 plus VAT. Since our purchase of the assets of Nascom Ltd, Nascom 1 and Nascom 2 kits have been offered alongside our range of business and educational machines and have continued to sell well, mainly in OEM form but also to end-users.

J B Garner,
Lucas Microcomputers,
Wedgnock Industrial Estate,
Warwick.

Microbee users

I AM a user of the Australian Z-80 based Microbee personal computer. It is good value for money as it has a built-in word processor and ADM3A terminal emulator in ROM with the Christensen protocol, battery backed-up CMOS RAM, 64-by-16 or 80-by-24 screen and has serial and parallel ports as standard fittings. The disc model is supplied with MBasic, WordStar, Multiplan and public domain CP/M utilities.

I know that the Microbee is sold in many European and Asian countries. I would like to get in touch with users outside Australia who would like to know more about the local scene. I would also like to see copies of Bee advertisements in foreign magazines. All letters will be answered.

Flt Lt Ash Nallawalla,
RAAF Academy,
Point Cook,
Vic 3029,
Australia.

Five years on

JUST TO let you know that I have picked up my prize in your Commodore Birthday Competition from Peter Walker Associates with whom I have been corresponding since November. I would like you to know that they were very helpful and considerate to me and managed to get most of my selection for me before Christmas.

As a result of this new toy in our household, two people previously uninterested in computers have now become computer fans. Amy, our two-year old, is not surprisingly fascinated with it. More remarkably her mother, previously a campaigning computerphobic, has become hooked so I now find difficulty in using the 64 as she is constantly at the keys.

Five years ago *Practical Computing* introduced me to the fascination of personal computers, and it looks as if this year you've done it again for the rest of my family. I can't tell you how pleased I am.

Trevor Hatchett,
Manchester.

CP/M recovery

MIKE LEWIS'S tip for recovering from a situation in which a CP/M BDOS error has aborted the program is to have a zero-length file on disc called Restart.Com. An attempt to load this file results in a jump to 100, the start of the transient program area, where the aborted program and all its variables should, with luck, be found intact.

Actually Restart.Com need not already be on disc. You can

SAVE 0 RESTART.COM

even after the crash. In fact you can perform any of the resident CP/M commands — Dir, Ren, Era, etc. — without mucking up your program because they do not use the TPA.

Even if you inadvertently use a non-resident command, such as Stat or Pip, all may not be lost. Restore will not get back your program but you can

SAVE 50 RAMBUFF.COM

the name is not important. You can then work on it with DDT or Zspat.

The Zspat utility is invaluable to anyone with CP/M. I don't know how I survived two years without it. It enables you to examine the disc sector by sector, jumping directly to any specified track/sector you wish and then to overwrite any ASCII data you find there. I only wish it could send a Null, Ctrl-L; it would be the handiest way of unerasing a file.

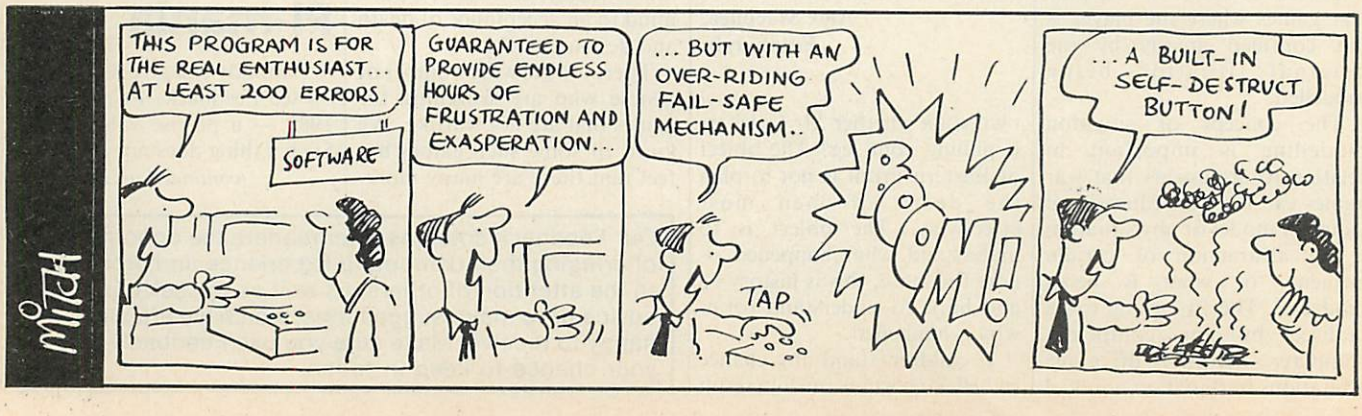
Malcolm Ross-Macdonald,
Offaly,
Ireland.

Acacia diary

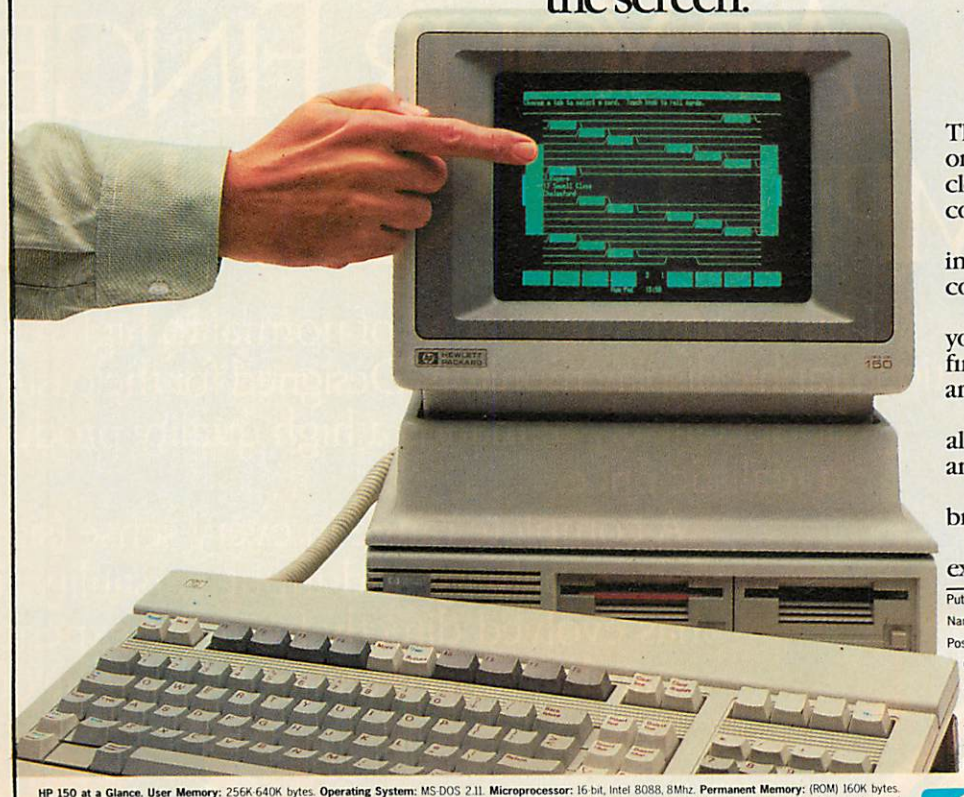
MANY THANKS to Neville Maude for his factual and accurate review of the Acacia's Electronic Diary system for the BBC Microcomputer. However, his comparison of the desk-top diary plus an alarm clock with our device on the price-only basis is not valid.

The Electronic Diary provides its user with facilities that are just not available with the paper version. A desk-top diary will not automatically sort out and display all the messages relevant to today, including the reminders from previous dates that have not been taken care of. It is possible to enter reminders beyond the end of this century. The equivalent desk-top diaries will occupy considerable space, and are not even in print yet.

Eugene Zabarski,
Acacia Computers Ltd,
Bromley,
Kent.


THIS PROGRAM IS FOR THE REAL ENTHUSIAST... AT LEAST 200 ERRORS
SOFTWARE
GUARANTEED TO PROVIDE ENDLESS HOURS OF FRUSTRATION AND EXASPERATION...
... BUT WITH AN OVER-RIDING FAIL-SAFE MECHANISM..
TAP
BOOM!
... A BUILT-IN SELF-DESTRUCT BUTTON!
MITCH

The personal computer anyone can operate simply by touching the screen.



The unique Touchscreen on the Hewlett-Packard 150 clears the mind wonderfully of computer confusion.

Anyone can put a finger instantly on what professional computing is all about.

Just by touching the screen you can edit a letter; make a chart; find an address; make a forecast; and tell it what to do next.

The Hewlett-Packard 150 also has a full keyboard – just like any ordinary computer.

And a price tag in the same bracket.

Get in touch on 0734 696622 extension 4252.

Put me in touch with the HP-150 Touchscreen Personal Computer.

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Position_____

Company_____

Address_____

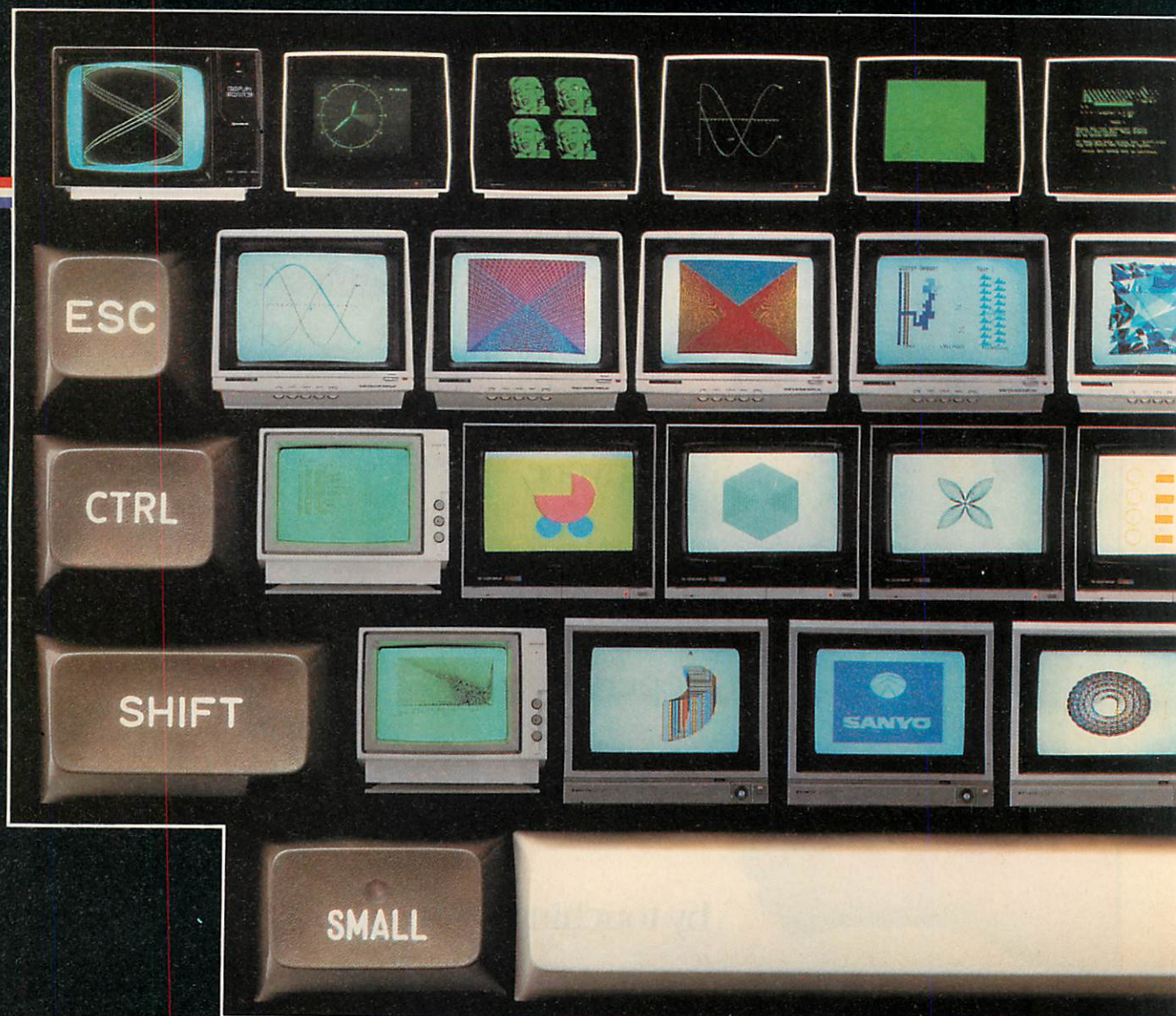
Telephone_____ PC4/84

To: Enquiry Section, Personal Computers, Hewlett-Packard Ltd., Eskdale Road, Winnersh, Wokingham, Berkshire RG11 5DZ.

HP 150 at a Glance. User Memory: 256K-640K bytes. **Operating System:** MS-DOS 2.11. **Microprocessor:** 16-bit, Intel 8088, 8Mhz. **Permanent Memory:** (ROM) 160K bytes. **Diagnostics:** Power-on self-testing. **Display Screen:** Touch-activated, green phosphor, 80 characters x 27 lines, 9 x 14 character matrix. Upper and lower case. Simultaneous text and graphics capability. 390v x 512h graphics resolution 1024 characters and symbols in ROM. **Keyboard:** 107 keys (total), 8-ft. cord attaches to system unit, 10-key numeric pad, 12 function keys (8 screen labelled). **Compact Size:** 2.1 sq. ft. desk space. **Communications:** 2 RS-232 ports (Built-in) HP-IB (EEE-488) (Built-in) IBM 3278 (SDLC, BSC), early 1984. Up to 19,200 bits per second DSN network link. **Peripherals:** Choice of printers (including optional internal printer), plotters, 3.5" floppy drives (264KB formatted), Winchester hard discs (5 and 15 Mbyte). *MS™/DOS is a trademark of Microsoft Corporation.

HEWLETT PACKARD

● Circle No. 104



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Road, Watford, Herts.

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PC4

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Mini's too expensive

For a multi-user business system expandable to 16 screens you used to need a sizeable mini, say from **DEC** or **Burroughs,** with a hefty price-tag for hardware and software, with long time-scales.

Micro's too small

Micros, like **Altos, Sage** and **Rair,** 8-bit or 16-bit, are doomed by CPU degradation, being based on the time-sharing principle. PCs, like **IBM** and **Apricot/Sirius,** just aren't in this league at all, networked or otherwise.

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multi-user system... ...is just right

SuperStar is a multi-processor system in which up to sixteen 16-bit processors, each with up to 1Mb RAM, are integrated in an attractive desk-top unit. All users can work at full speed in genuine multi-user, multi-tasking mode with full file/record locking and spooling.

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£5975 buys a complete 2-user high-performance system, with 10Mb winchester and VDUs. Additional users for £995 each, including VDU and processor.

Supports all **CP/M** and **MS-DOS** programs as well as the wide range of **BROMCOM** genuine multi-user software.

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OEM, Dealer and Overseas enquiries are welcomed.

SuperStar is a trade mark of Bromley Computer Consultancy. CP/M is a trade mark of Digital Research. MS-DOS is a trade mark of MICROSOFT.

SuperStar-16 has a 16-bit Master Processor which runs IMPOS (BROMCOM designed true 16-bit controlling operating system). IMPOS supports CP/M, MS-DOS and shortly Xenix in slave processors in any combination and it is fully upward compatible with ACTION DPC/OS, Televideo MmmOST and TurboDOS.

● Circle No. 106

Sanyo's 16 bits

SANYO HAS launched two new machines based on the 8088 processor, running under MS-DOS. The MBC-550 is the entry machine with up to 256K of RAM and 8K of ROM. The 550 has one floppy with a capacity of 160K and the MBC-555 has two.

The detachable keyboard is connected by a coiled cord and has five function keys in addition to a numeric keypad. The monitor is extra; both high-resolution mono and colour options are available. A Centronics port is provided as standard, with an additional RS-232 option.

The MBC-550 comes with WordStar and Calcstar, and the 555 also offers Spellstar, Mailmerge and Datastar among others as standard. It is claimed that a substantial amount of IBM PC compatible software can be run.

The MBC-550 costs £699 plus VAT, and the MBC-555 sells for £899. Details from Sanyo Marubeni (U.K.) Limited, 8 Greycaine Estate, Watford, Hertfordshire WD2 4QU. Telephone: Watford 46363.

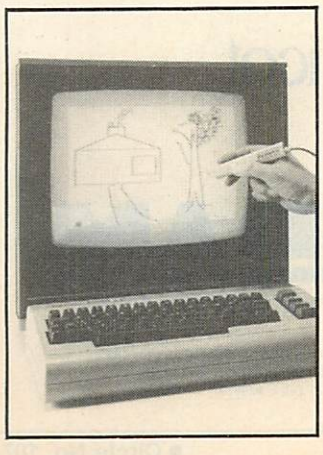
Datapen Lightpen

DATAPEN'S LIGHTPEN allows high-resolution pictures to be generated on the BBC Micro, Dragon 32, Vic-20 and Commodore 64. It is used in conjunction with the associated software package Hi-res Draw.

An on-screen menu normally resides at the bottom of the screen. Toggling it on or off permits both freehand and accurate line drawing.

A further program called Colour-Draw allows the colour facilities of the micros to be utilised on screen. Intro is used to move sprite graphics. Graphics may be saved to tape at any point.

The Datapen Lightpen together with the three programs and a handbook cost £25, inclusive of VAT and postage. Details from Datapen Microtechnology Limited, Kingsclere Road, Overton, Hampshire RG25 3JB.



16032 upgrade for Z-80 micros

RESEARCH MACHINES 380Z machines and S-100 based micros based on a Z-80 CPU can now be upgraded to run National Semiconductor's powerful new 32-bit 16032 processor.

The 16032 uses the Z-80 for all I/O operations, so there is no need to rewrite the disc-operating software. As a result, the user can swap easily between CP/M and the 16032's multi-tasking operating system MDOS-16000.

A macroassembler and a text editor, are supplied with the system. Pascal and Fortran compilers are promised too. Both will generate native code for the 16032, rather than using the slower intermediate p-code system.

Kit-1 costs £1,795. As well as the 16032 it includes an additional floating-point arithmetic chip. Further information can be obtained from Merlin Microcomputers Limited, 6 Wesley House Cottage, New Inn Hall Street, Oxford OX1 2DW. Telephone: (0865) 251255.

8086 on a Rana

THE RANA 8086/2 allows the Apple II to run both MS-DOS and standard Apple DOS programs. The appropriate operating system is selected automatically according to the format of the disc inserted.

The 8086-based system comes complete with two disc drives, 356K of RAM and video circuitry allowing various text and graphics modes. Software included with the system is MS-DOS, GWBasic and Microsoft Windows.

The system costs about £1,300 and is available from Pete & Pam Computers, New Hall Hey Road, Rawtenstall, Rossendale, Lancashire. Telephone: (0706) 212321.

Brother computer typewriter

BROTHER'S EP-44 offers a range of functions from electronic typewriter to full duplex send-and-receive computer terminal. The unit is powered by four standard 1.5V batteries, and weighs less than 5lb. An adaptor is also available for mains operation.

In addition to a button-type keyboard — like the IBM PCjr — there is a 15-character liquid-crystal display unit and a dense 24-by-18 non-impact dot-matrix printer. This thermal head is claimed to provide letter-quality print with true ascenders and descenders on lower-case letters.

The machine possesses a

(continued on page 15)

Shorts

● Digital Research's Soft Net is available for the Future range of micros. The system runs on Concurrent CP/M and requires a £184 RAM upgrade to 256K. The network system itself will either cost £10 per unit or £100 for a complete configuration. Details from Future. Telephone: 01-683 0111.

● The A3 and A4 digital graphics plotters from Gould Bryans have been reduced in price. The A4 version with seven colour pens now costs £1,495 instead of £1,895, and the 10-pen A3 is now £1,995 instead of £2,290. Information on 01-640 3490.

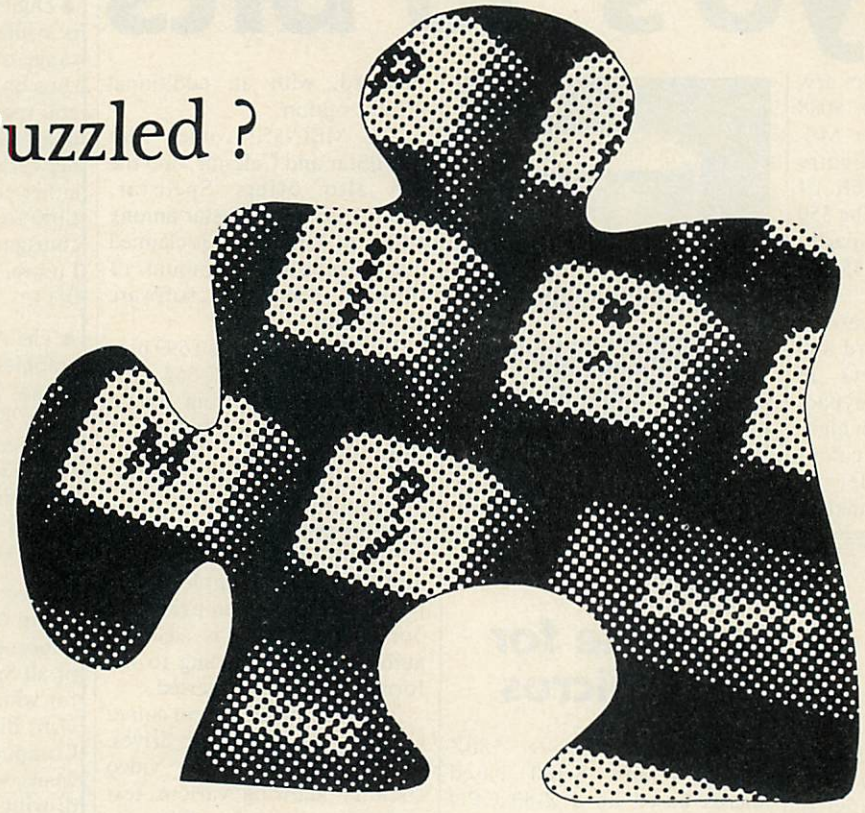
● Spectravideo Ltd has been set up to handle the importation and distribution of all Spectravideo products, for which it will have sole U.K. distribution rights. CK Computers of Weston-Super-Mare, which hitherto has distributed the Spectravideo SV-318 and SV-328, will continue to deal with the machines, acting as a link to the small retailer section of the distribution market.

● Plessey is introducing a new micro built around the iAPX 80186 processor running at 8MHz. The machine will come with 256K of RAM as standard, together with two 400K 3.5in. floppies. Also included in the £1,895 price is a monitor, keyboard and one operating system. Further information from Plessey. Telephone: (0602) 254822.

● The Ampex Pyxis 5.25in. Winchester sub-system can be hooked up to a range of machines including the Apple II and IBM PC. The basic unit costs from £1,767 for the 5Mbyte version to £2,518 for the 20Mbyte system. Interface adaptors for specific machines cost from £107 for the Apple to £142 for the IBM PC. Telephone: (04215) 66321.

● GEC McMichael Ltd, the consumer electronics division of GEC, has taken over the sales and marketing functions for all Dragon products within the U.K.

Puzzled ?



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(continued from page 13)
4,000 character memory and RS-232 interface. A number of word-processing functions are available, including automatic carriage return at line end, line centring and underlining and superscript and subscript printing.

The EP-44 costs £220 plus VAT. Brother has also announced the HR-5 computer printer, with 80 columns and a non-impact dot-matrix head. The price is £179.95 plus VAT.

Details may be obtained from Brother Office Equipment Division, Shepley Street, Guide Bridge, Audenshaw, Manchester M34 5JD. Telephone: 061-330 0111.

Graphics pad

THE KOALA PAINTER graphics pad, is now available for Apple and Atari micros. The Apple version costrs £91.60 and can be obtained from Pete & Pam Computers. Telephone: (0706) 227011. The Atari version costs £69 and comes from Silica Shop Ltd. Telephone: 01-310 1111.

Optim Personal

THE OPTIM 1050 personal computer has two processors, a Z-80A and a 6502, but is not Apple compatible. The Z-80A is used as the CPU and handles 128K of RAM, while the 6502 controls the screen, providing 640-by-300 pixel bit-mapped graphics.

It has twin 400K floppy-disc drives which are said to read Kaypro and DEC Rainbow disc formats too. In other respects the Optim 1050 is a fairly standard system with a 93-key detached keyboard featuring a numeric keypad and 17 function keys.

Software bundled with the package is WordStar, Mailmerge, Multiplan and DR Graph, plus CBasic. The price is £1,995.

Contact Optim Computer Group plc, Lawford House, Harrow Road, London W10 4RE. Telephone: 01-969 6768.

Class warfare

THE BATTLE for the minds of today's youth is hotting up. Until March 31 Apple is offering educational establishments 30 percent off a range of Apple II and III systems. As reported last month in *Practical Computing* Commodore is currently promoting an educational package with a saving of £170 on the list price of £469.99.

In retaliation to all this transatlantic hard sell, Acorn Computers is striking back by offering a $995 package to American schools and colleges. It consists of the BBC Micro, disc unit, speech synthesis and word-processing software. Econet is also included. Acorn aims to capture a major share of the market by the end of 1984 — and that market is estimated as being worth over $600 million by 1986.

Details of the Apple and Commodore schemes can be obtained from local dealers.

BBC digitiser

A VIDEO DIGITISER for the BBC Micro has been produced by R H Electronics Ltd. The unit comes complete with power supply, and is connected to the computer using the 1MHz bus. The digitiser can be used with any video source, including a video camera or recorder.

The software is supplied on a ROM chip that plugs into one of the micro's spare slots. The digitised image may be displayed in all graphics modes of the BBC Micro, stored on disc or cassette and reproduced on an Epson printer.

A software package called Artfun allows selected portions of a digitised image to be blown up and modified with a light-pen.

The digitiser costs £212.50 plus VAT, and Artfun costs £11.95 and £9.95 for the disc and cassette versions respectively. Details can be obtained from R H Electronics Ltd, Chesterton Mill, French's Road, Cambridge CB4 3NP. Telephone: (0223) 311290.

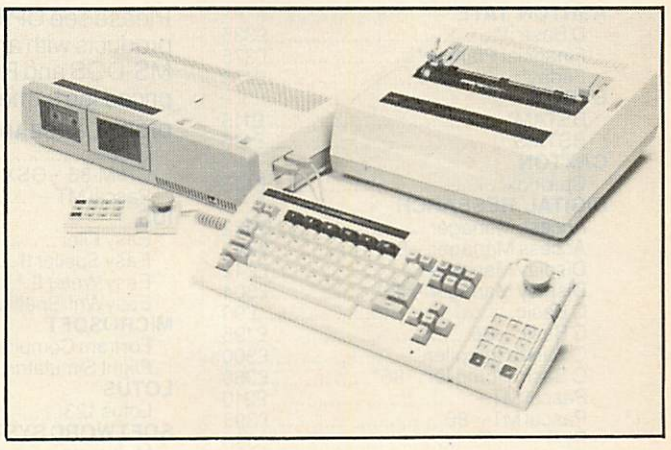
Coleco Adam — nearly here

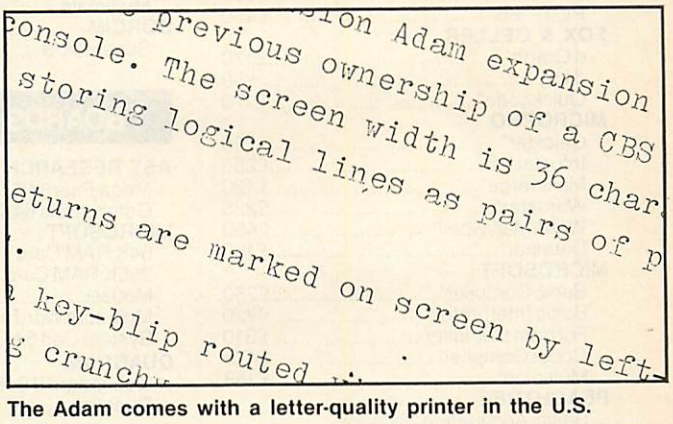
THE LONG-AWAITED Coleco Adam almost put in an appearance at the recent Toy Fair in London, but in fact versions shown were still plugged into the CBS Colecovision video-games machine. In this form it is known as Expansion Module 3, which doesn't have quite the same ring to it.

The CBS Colecovision has a Z-80 with 16K of RAM. What is inside the Expansion Module remains a mystery, except for the Applesoft-type Basic, and the word processor into which the Adam boots on powering on. The word processor imitates a typewriter in design: you type on to a black "roller" as the video "paper" scrolls past.

In the U.S. the Adam is supplied with a cheap letter-quality printer, plus a game which is called Buck Rogers — Planet of Zoom.

The price of the Expansion Module package is expected to be in the £600 to £700 range. Contact CBS Electronics, Headingly Road East, Woodley, Berkshire. Telephone: (0734) 698188.




ion Adam expansion
previous ownership of a CBS
console. The screen width is 36 char
storing logical lines as pairs of p
eturns are marked on screen by left
key-blip routed

The Adam comes with a letter-quality printer in the U.S.

Now you can fight off the hordes of invading aliens with a British-made joystick, the Pro Ace. It has two fire buttons, one placed centrally on the base for both right- and left-handers, plus one on top of the control column. So far the Pro Ace is available in the standard Atari fitting, which is also suitable for Commodore machines, most video games and Spectrum add-ons. BBC and Dragon versions are to follow. The Pro Ace costs £12.95. Contact Sumlock Microware, 198 Deansgate, Manchester M3 3NE. Telephone: 061-834 4233.

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- Pascal MT+ 86 ..... £395
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- PL/1 – 86* £450

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- d Graph* £170
- d Util* £60
- Quickcode* £170

MICROPRO
- Calcstar* £95
- Infostar* £255
- Mailmerge* £120
- Wordstar* £225
- Word/Mail/Spell* £450
- Datastar* £150

MICROSOFT
- Basic Compiler* £250
- Basic Interpreter* £220
- Fortram Complier £310
- Cobol Compiler* £475
- Multiplan* £168

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- Basic Accounting System per module £300
- Business Management Systems per module £550
- Peachcalc* £80
- Peachtext* £155
- Peachpack* £300

SORCIM
- Supercalc* £105
- Supercalc 2* £165
- Superwriter* £255

SAGE
- Accounting* £350

Most popular machine formats are available.

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Please see CP/M listing. All products with an * will also run on MS-DOS and PC-DOS and are priced the same.

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- Pascal MT+ £265

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- Easy Filer £235
- Easy Speller II £120
- Easy Writer II £185
- EasyWrit/Spell/Mail £385

MICROSOFT
- Fortram Compiler £235
- Flight Simulator £39

LOTUS
- Lotus 123 ..... £330

SOFTWORD SYSTEMS
- Multimate £309

SORCIM
- Supercalc 3 ..... £265

BOARDS FOR IBM/PC

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- Combo Plus 64K £288

MICROSOFT
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- Quadboard II 64K RAM £280
- Quadlink £495

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- Kaga RGB Vision-III 12" £369

SANYO
- Sanyo 12" Hi-Res Green £98

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- Epson FX-80 ..... £349

JUKI
- Juki 6100 ..... £399

MANNSMAN-TALLY
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- MT 160 ..... £449

STAR
- Delta-10 ..... £329
- Gemini 10X £199
- Gemini 15X £329

All products subject to availability. CP/M is a registered trademark of Digital Research, IBM is the registered trademark of International Business Machines.

We cannot list all the products we carry – please call for further details.

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Commodore 64 Sid chips

A COMMODORE TECHNOTE from Slough reads as follows: "Because of the variations in Sid chips, it is not advisable to include the filter in the sound of commercial software. Doing so may result in sounds that are unexpected or not audible on some 64s. There is, of course, no problem in setting the filter in software one writes to one's own computer."

If you have experienced problems with sound in commercial software this could be the reason, and it is worth mentioning the fact to the author of the program.

QLMON

HAVE YOU ordered your amazing Sinclair QL yet? If so, when? Please fill in the small questionnaire, including the estimated date of arrival. When the machine actually arrives, fill in the date and send us the form. Take a photostat if you want to avoid cutting up the magazine.

It will come as no surprise to regular readers of this magazine that Sinclair has, yet again, been overwhelmed by the size of the demand, which has been described as "phenomenal". With your assistance, we will try to track deliveries and monitor the state of the waiting list.

Practical Computing QLMON

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Actual delivery date.....

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Post completed coupon to: QLMON, Practical Computing, Room L306, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

Bad Apples

A U.S. GRAND JURY has indicted six people and five companies on charges of criminal conspiracy and smuggling counterfeit Apple micros and software into the U.S. from Taiwan.

This is the first time criminal charges have been brought, as opposed to civil ones, according to a report in the *Wall Street Journal*.

Apple has also filed criminal charges in Italy and Taiwan, while there are more than 50 lawsuits alleging copyright infringement in 16 countries. In Taiwan, six computer company executives have been sentenced to eight-month prison terms for pirating Apple software.

Info for free

PRACTICAL COMPUTING magazine is published by Business Press International, the world's largest publisher of business magazines. Computer publications in the group range from *Computer Choice* to *Your Computer* to *Computer Weekly*, and general magazines ranging from *Amateur Photographer* to *Yachting World*.

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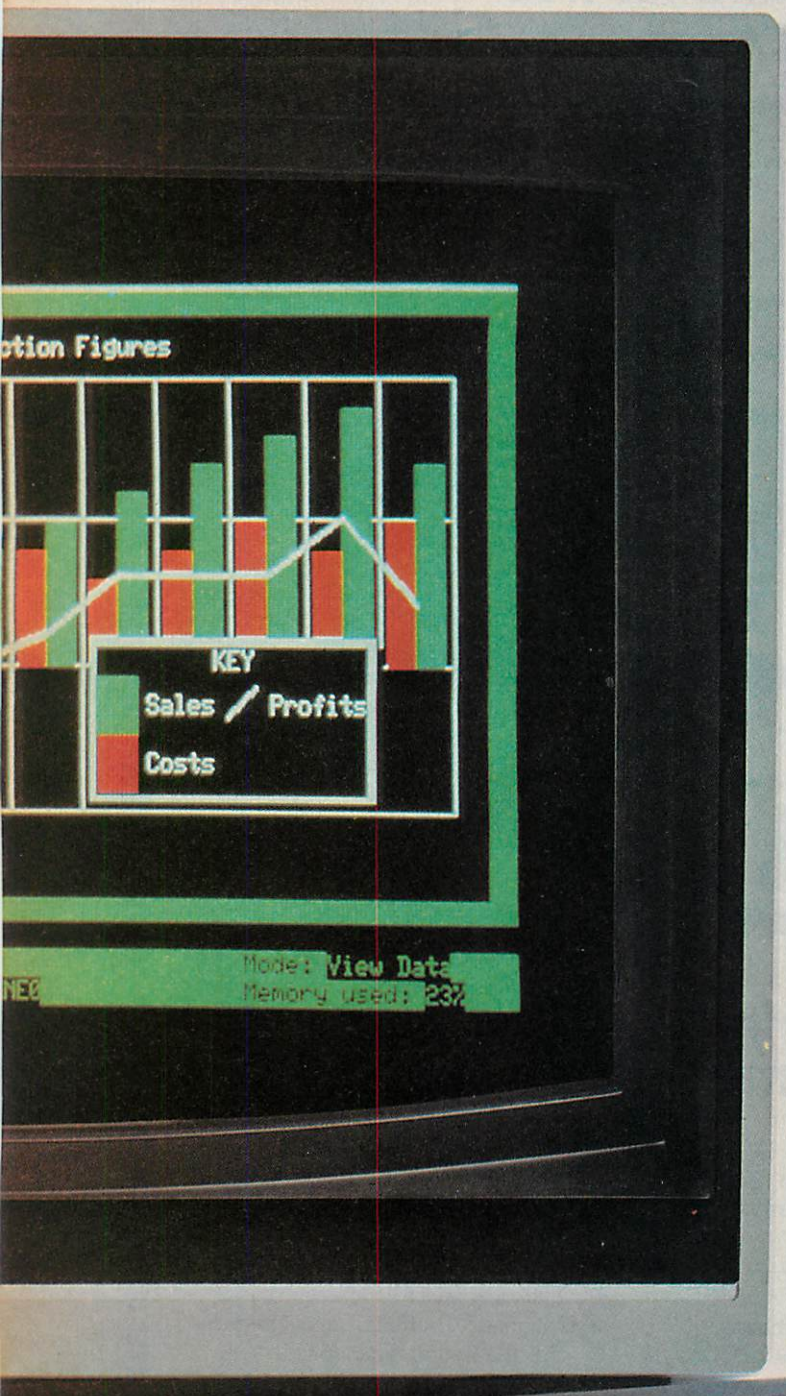
New-Sinclair QL

There's no comparison chart,



The Sinclair QL is a new computer.

Not just a new Sinclair computer, but a totally new sort of computer – nothing like it exists anywhere.

It's not just a bit better than this, or a bit cheaper than that – it's a computer that's very hard to compare with anything. Just check the features below – and if you don't agree, take up the challenge at the end of the advertisement.

If you do agree, there's only one course of action you can take... get yourself a Sinclair QL at the earliest possible moment.

The Sinclair QL has 128K RAM. Big deal?

Several micros offer 128K RAM, or more, as standard. The 'What Micro?' table for December 1983 lists over 50 of them – but 40 of the 50 micros listed cost over £2,500!

The Sinclair QL offers you 128K RAM for under £400, and an option to expand to 640K. That's a lot of bytes to the pound!

The Sinclair QL has a 32-bit processor. Who else?

Under £2,700, nobody. Even the new generation of business computers, such as the IBM PC, are only now beginning to use 16-bit processors.

At prices like this, the Motorola 68000 family – widely regarded as the most powerful microprocessors available – will remain a luxury.

Yet with the Sinclair QL, the 32-bit Motorola 68008 is available for less than £400.

You can also be sure that the QL will not become outdated. 32-bit architecture is future-proof.

32-bit processor architecture, 128K RAM, and QDOS combine to give the QL the performance of a mini-computer for the price of a micro.

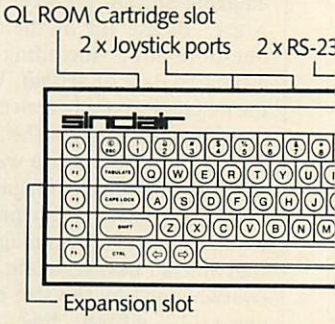
Exclusive: new QDOS operating system

No competition! QDOS sets a new standard in operating systems for the 68000 family of processors, and may well become the industry standard.

QDOS is a single-user, multi-tasking, time-sliced system using Sinclair's new SuperBASIC as a command language.

One of its most significant features is its very powerful multi-tasking capability – the ability to run several programs individually and simultaneously. It can also display the results simultaneously in different portions of the screen. These are features not normally available on computers costing less than £7,000.

Eleven input/output ports

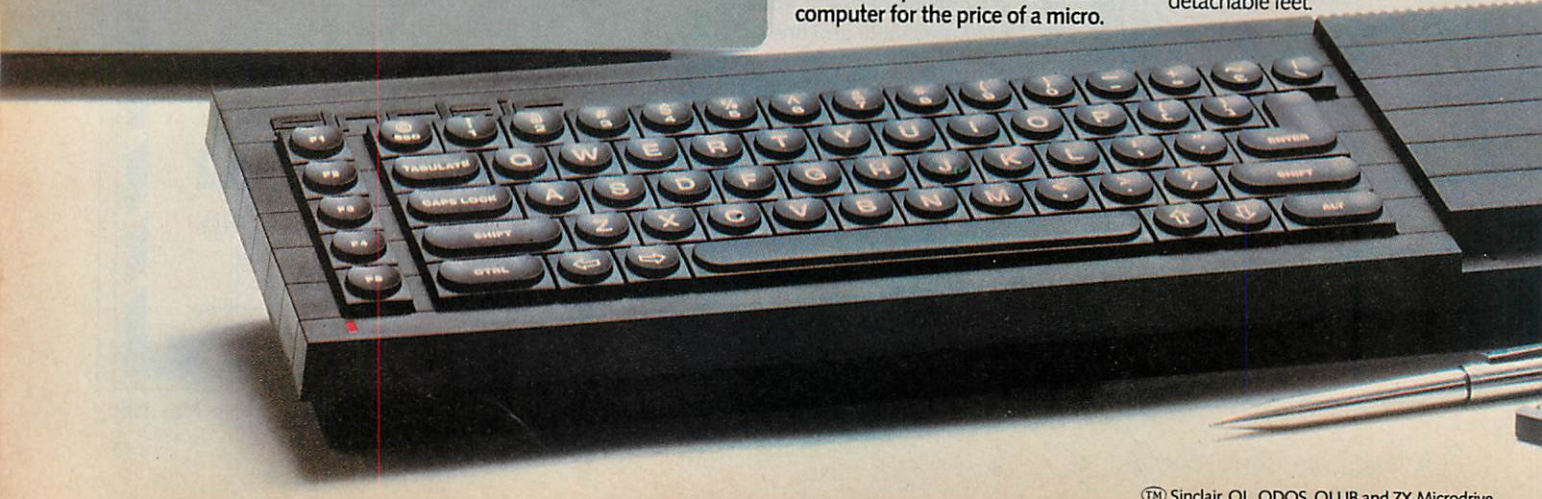


New professional keyboard

The QL keyboard is designed for fast input of data and programs.

It is a full-size QWERTY keyboard, with 65 keys, including a space bar; left-and right-hand shift keys; five function keys; and four separate cursor-control keys – key action is positive and precise

A membrane beneath the keyboard protects the machine from dust (and coffee!), and for users who find an angled keyboard more comfortable, the computer can be raised slightly at the back by small detachable feet.



™ Sinclair, QL, QDOS, QLUB and ZX Microdrive are trade marks of Sinclair Research Ltd.

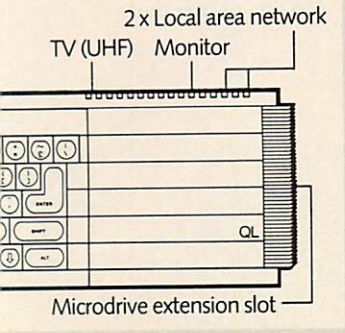
£399

ecause there's no comparison!

Advanced new friendly language – Sinclair SuperBASIC

The new Sinclair SuperBASIC combines the familiarity of BASIC with a number of major developments which allow the QL's full power to be exploited.

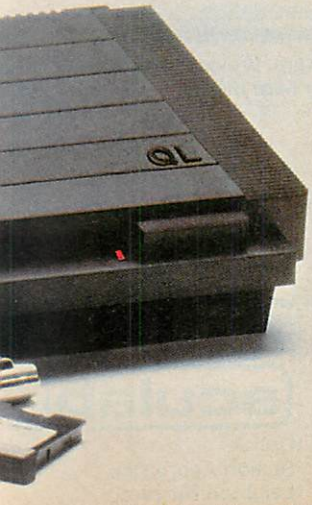
Unlike conventional BASIC, its procedure facility allows code to be written in clearly-defined blocks; extendability allows new procedures to be added which will work in exactly the same way as the command procedures built into the ROM; and its constant execution speed means that SuperBASIC does not get slower as programs get larger.



Two 100K microdrives built in

The Microdrives for the Sinclair QL are identical in principle to the popular and proven ZX Microdrives, but give increased capacity (at least 100K bytes each) and a faster data-transfer rate. Typical access speed is 3.5 seconds, and loading is at up to 15K bytes per second. The Sinclair QL has two built-in Microdrives. If required, a further six units can be connected.

Four blank cartridges are supplied with the machine.



Included – superb professional software

The suite of four programs is written by Psion specially for the QL and incorporates many major developments. All programs use full colour, and data is transportable from one to another. (For example, figures can be transferred from spreadsheet to graphics for an instant visual presentation.)

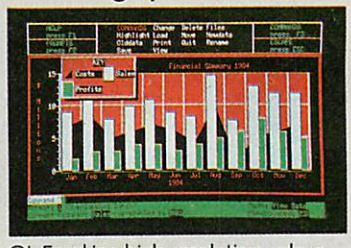
Word-processing

Certain to set a new standard of excellence, QL Quill uses the power of the QL to show on the screen exactly what you key in, and to print out exactly what you see on the screen.

A beginner can be using QL Quill for word-processing within minutes.

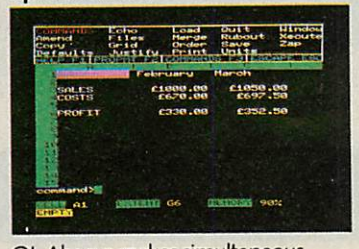
QL Quill brings you all the facilities of a very advanced word-processing package.

Business graphics



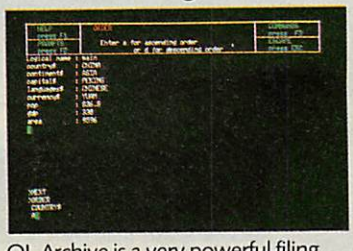
QL Easel is a high-resolution colour program so easy to use you probably won't refer to the manual! It handles anything from lines, shaded curves or histograms to overlapping or stacked bars or pie charts. QL Easel does not require you to format your display before entering data; it handles design and scaling automatically or under your control. Text can be added and altered as simply as data.

Spreadsheet



QL Abacus makes simultaneous calculations and 'what if' model-construction easier than they've ever been. Sample applications are provided, including budget-planning and cash-flow analysis. QL Abacus allows you to refer to rows, columns and cells by names, not just letters and numbers. Function keys can be assigned to change a variable and carry out a complete 'what if' calculation with a single key-stroke.

Database management



QL Archive is a very powerful filing system which sets new standards, using a language even simpler than BASIC. It combines ease of use for simple applications – such as card indices – with huge power as a multi-file data processor.

An easy-to-use labelling facility means that you don't have to ask for your file by its full name – a few letters are enough.

New – the Sinclair QLUB

The QLUB is the QL Users Bureau. Membership is open to all QL owners. For an annual subscription of £35, QLUB members receive one free update to each of the four programs supplied with the QL, and six bi-monthly newsletters. Sinclair has also made exclusive arrangements for QLUB members to obtain software assistance on QL Quill, Abacus, Archive or Easel by writing to Psion.

The Sinclair QL challenge

If you're seriously considering any other computer, post the coupon for a blow-by-blow comparison. We'll take a *published* comparison chart for the machine you're considering (not one we've created ourselves) and give you the Sinclair QL figures, detail by detail.

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DASH-80

SOFTWARE INCLUDED

CP/M 80[1]
CP/M utilities
System utilities
WORDSTAR[2]
CALCSTAR[2]
PERSONAL PEARL[3]
On line HELP file

HARDWARE DESCRIPTION

6mHz Z80B processor
128k RAM
Ultra fast 'cache' disks
One/two 5¼" disk drives
Up to 1568k disk storage
Two RS232 serial ports
Parallel printer port

The **DASH-80**, designed and assembled in Great Britain to exploit the vast range of CP/M based application software, provides a processor performance that exceeds that of most current 16-bit systems and floppy disk access times as fast as those of many hard disks.

The **DASH-80** comes complete with a selection of powerful software tools including:

WORDSTAR, the world's most popular word processor software,
CALCSTAR, wordstar compatible electronic spreadsheet,
PERSONAL PEARL, a powerful data base application generator.

DASH-80 processor prices (inclusive of software) start at — **£1084.00** (RRP, excl VAT),
DASH-10 terminal shown above — **£ 560.00** (RRP, excl VAT).

For further information on the system, and for details and listings of disk and processor benchmarks, telephone or write to the address shown below:

PROCESSOR BENCHMARKS

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8
DASH-80	.73	2.4	6.6	6.5	7.0	12.7	20.2	34.3
IBM PC	1.2	4.8	11.7	12.2	13.4	23.3	37.4	30.0
APRICOT	1.5	4.8	10.4	10.8	12.2	22.8	35.5	34.0
SIRIUS	1.7	5.4	11.1	11.5	13.6	26.2	40.1	29.0

DISK BENCHMARKS

DBM1	DBM2	DBM3	DBM4	DBM5
0.6	4.3	4.2	3.8	3.7
3.8	21.2	20.8	12.7	10.4
3.0	9.5	14.0	8.0	7.5
2.5	37.0	37.0	12.0	12.0

Trademarks: (1) Digital Research, (2) Micropro, (3) Relational Systems.

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Leighton Buzzard,
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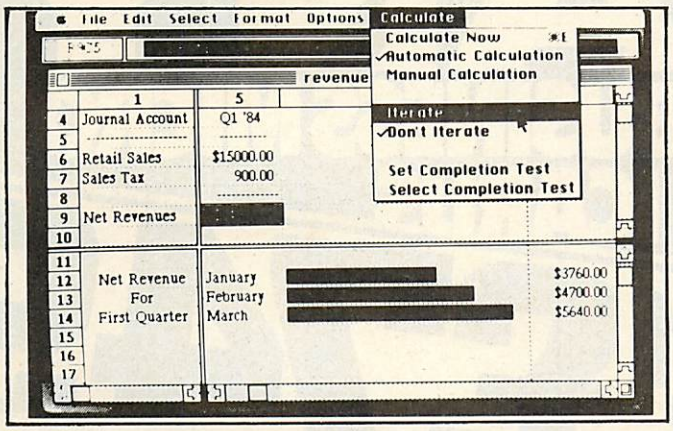
0525 371393

Microsoft backs Macintosh

MICROSOFT is backing Apple's new Macintosh, reviewed in the March issue of *Practical Computing*, with its range of application programs. First to be implemented are Multiplan and Word, along with two new programs, File and Chart. Microsoft File is a database-management program, and Chart a graphics package. Data is said to be interchangeable between the programs. Microsoft Basic will also be made available.

Multiplan has several useful enhancements, such as an Undo command to reverse the last change. Printing options now include headers, footers and automatic page numbering.



The Microsoft programs do not follow the style that has become well known from implementations on other micros. Instead they use pull-down menus like Macword and Macpoint.

Contact Microsoft Ltd, Piper House, Hatch Lane, Windsor Berkshire. Tel: (07535) 59951.

Jack-2

AFTER The Incredible Jack comes Jack-2, the Apple II version of the integrated program originally written for the IBM PC. Jack does word processing, calc-sheeting, charting and filing or database management on screen at the same time without windows.

Contact Business Solutions Inc., 60 East Main Street, Kings Park, New York NY 11754. Telephone: (area code 516) 269-1120. Or contact Pete & Pam, New Hall Hey Road, Rossendale, Lancashire BB4 6JG. Telephone: (0706) 212321.

QL support

IT MAY BE impossible to get hold of a Sinclair QL, but the quaintly named software house Joe the Lion has already announced the first of a range of programs.

The program is called the Spectrum Emulator, and it is claimed it will allow the QL to load and run Spectrum machine-code programs. It is supplied on a Microdrive tape and comes with a connector to allow a cassette recorder to be connected to the QL.

The price is expected to be around £25. Contact Joe the Lion at 213-215 Market Street, Hyde, Cheshire SK14 1HF.

Meanwhile, Leon Heller and Brian Pain launched an independent QL users' group called, acronymically, IQLUG. The first 16-page news letter has already been published. Price is £3.25 for a trial six-month subscription.

Contact Brian Pain, Acting Secretary, at 24 Oxford Street, Stony Stratford, Milton Keynes, Buckinghamshire. Telephone: (0908) 564271.

See Jane run

JANE is a fascinating piece of integrated software, just like the Incredible Jack. The differences are that Jane uses little drawings or icons, is mouse operated, and has overlapping windows.

Jane comes complete with Janewrite, Janecalc and Janelist on a single disc, plus a three-button mouse. One of the designers, Bobby Kotick, describes it modestly as "similar in principle to the Apple Lisa and Xerox work station, but Jane goes much further. It creates the ultimate interactive environment for the user".

Jane was written by Kotick

and Howard Marks, undergraduates aged 20 and 21, and room-mates at the University of Michigan. Launch investment came from the chairman of the Golden Nugget hotels and casinos in Las Vegas and Atlantic City. However, the man running the new company, James Spillers, certainly knows the business: he spent 14 years at Xerox and was vice-president of Microsoft. Sales of 100,000 programs are projected for Jane in 1984.

So far you can only see Jane run on an Apple II micro. However, it is claimed to be easy to transfer to any machine with 64K of RAM. Commodore 64, IBM PC, PCjr and Atari 800XL versions are under development.

Retail price in the U.S. is only $295. So far Jane is not

(continued on page 23)

Software flashes

● Raymond Briggs' twee Snowman character features in one of Quicksilva's new games for the 48K Spectrum. Other new Spectrum games are Dragonsbane, Fred, and Jeff Minter's Laserzone. Telephone: (0703) 37497.

● Pcalc is a spreadsheet for the Kyocera lap computers: the NEC 8201A, Tandy Model 100 and Olivetti M-10. It costs £25 from Capra-Cinderstan Associates, 5 Oliver Court, South Hill Park Gardens, London NW3 2TE. Telephone: 01-794 8899.

● Gemini Marketing's database for the BBC Micro is now available on ROM for users with disc drives. Gemini is also to supply a suite of business software including purchase and sales ledgers, invoicing and payroll at £99.95 per module. Telephone: (0395) 265165.

● Interior Designers can now do it on the Spectrum. Richard Williams' program will also print out room plans, and at £4.95 could be worth having even if you are just moving house. Contact Richard Williams, 84 Brentmoor Road, Bramhall, Stockport SK7 3PY.

● BBC Micro owners can now obtain more good-value software from Beebugsoft. The new offerings are Toolbox, Paintbox, Teletext Pack and Design. Toolkit is on EPROM; the others are available on either cassette or disc. Contact Beebug Publications, PO Box 50, St. Albans, Hertfordshire.

● Y Software has produced a neat utility called TH for CP/M micros. TH stands for Text Handler. It allows the text part of programs, such as help menus and error messages, to be held in separate files from compiled machine-code programs in MBasic, Macro-80 and ProPascal. The result is smaller, faster programs with longer, more helpful text screens. Contact Y Software, 34 Watson Road, Killiney, Co. Dublin, Ireland.

● Circle No. 111

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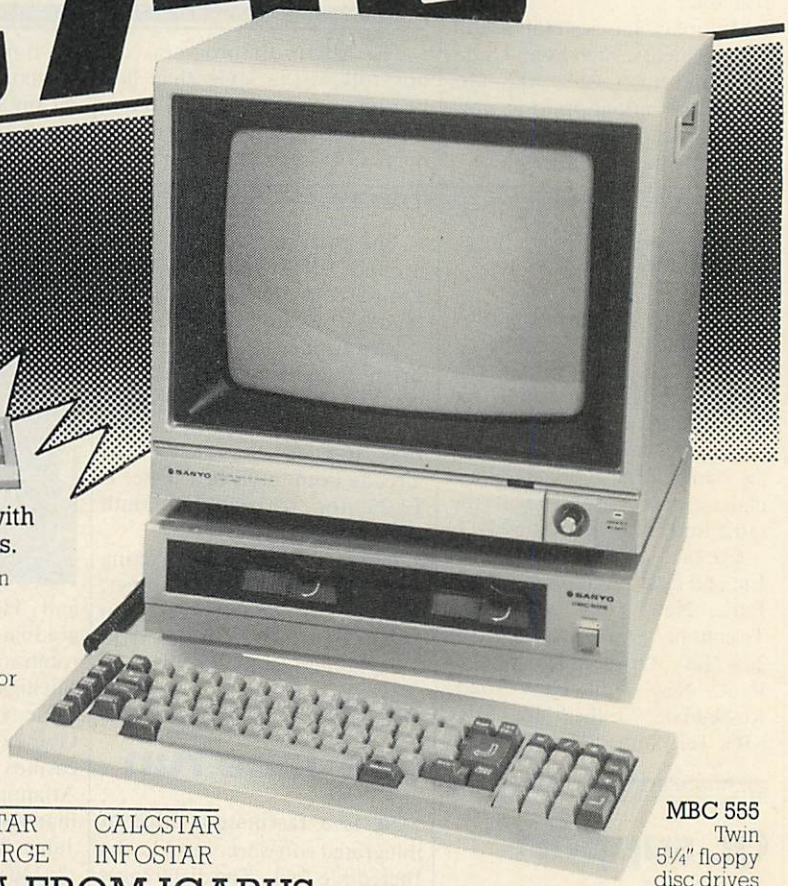

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ICARUS

ICARUS COMPUTER SYSTEMS LTD, Deane House, 27 Greenwood Place, London NW5 1NN. Tel: 01-485 5574. Telex: 264209

● **Circle No. 112**

(continued from page 21)
available in the U.K. However, Arktronics can be contacted at 113 South Fourth Avenue, Ann Arbor, Mi 48104. Telephone: (area code 313) 769-7253.

Jane is marketed as "the most simple way to operate a computer". Shouldn't that be "simplest"?

Lifeboat

SOFTWARE supplier Lifeboat Associates has closed its London office. Distribution and support is being taken over by Roundhill Computer Systems. Products include the Lattice C compiler, now available in a new, revised version for MS-DOS and PC-DOS 2 and offering a megabyte of address space.

Contact Roundhill Computer Systems Ltd, Axholme, London Road, Marlborough, Wiltshire SN8 1LR. Telephone: (0672) 54675.

HX-20 meets Prestel

ADD A MODEM or acoustic coupler along with the Deskmaster 20 HX-Viewdata program and the Epson HX-20 can talk to the Prestel computers. At least it can if the HX-20 packs 32K of RAM. Kuma Computers, which supplies the software, also has a 16K RAM upgrade board that fits inside the HX-20 case.

Another Kuma package for the HX-20 is Deskmaster 17 Pert and Critical Path Analysis Program. If you don't know what it does, you don't need it.

Contact Kuma Computers Ltd, Unit 12, Horseshoe Park, Horseshoe Road, Pangbourne, Berkshire RG8 7JW. Telephone: (07357) 4335.

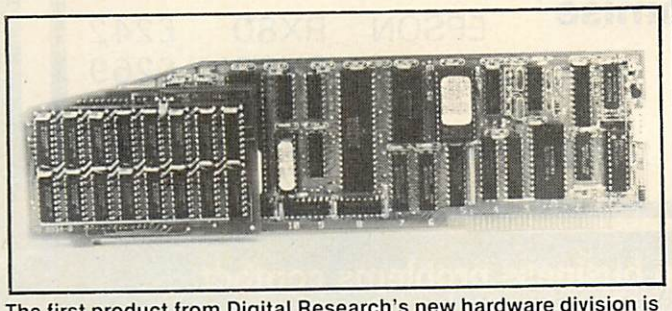
68000 takeover?

TODAY'S CHIP is certainly Intel's 8086/8, as used in the IBM PC, Sirius and ACT Apricot micros. Tomorrow's chip could be the Motorola 68000. This is the CPU family used by Apple's Macintosh and the Sinclair QL, as well as powerful machines like the Sage II, Fortune 32:16 and Wicat 150.

One problem with 68000 based micros is a slight shortage of applications software. Digital Research is planning to plug that gap with a version of its forthcoming operating system Concurrent DOS, which is expected to be released around the end of this year.

The point about C-DOS is that it will allow programs written for the IBM PC under PC-DOS to run on 68000-based micros. It has not escaped anyone's notice that PC-DOS is a version of the MS-DOS produced by Digital Research's arch-rival Microsoft. A case of, if you can't beat 'em, outsmart 'em?

In theory, it should be possible to implement C-DOS on the Sinclair QL. This would allow the QL to run IBM PC software at a somewhat lower price than is likely to be offered by IBM.



The first product from Digital Research's new hardware division is a Gold Card for the Apple II. It provides CP/M, which is hardly news, but the use of a 6MHz Z-80 is said to allow applications to run three times faster than with competitive cards. The Gold Card also provides an 80-column screen and CP/M Plus, as reviewed in Practical Computing, October 1983 issue. It costs £399. A further version of the card offers 128K of RAM instead of 64K, plus a cache memory, and costs £640. Contact Digital Research, Oxford House, Oxford Street, Newbury, Berkshire RG13 1JB. Telephone: (0635) 35304.

C for 8086/8

THE DESMET C COMPILER is now available from MLH Technology for the Sirius, Apricot and IBM PC. Operating systems supported are MS-DOS and PC-DOS, with CP/M-86 to follow shortly.

The package includes an extensive set of utilities: compiler, linker, assembler, screen editor, cross referencer, full-function library and demonstration programs. Assembly language may be included in the C source files. In addition, there are no royalties on generated code, so users can sell or distribute programs produced with the compiler.

With the recent growth of interest in C, MLH has priced the package at only £125 plus VAT, to try to capture a wide market. The manual may be purchased separately for £20; if you subsequently buy the package the £20 can be deducted from the price.

Contract MLH Technology, 14 Burgamot Lane, Comberbach, Cheshire CW9 6PB.

Graphics pack for Sirius

KEYDRAW is a text-illustration and graphics package for the Sirius 1 from Tarot Ltd, the supplier of Keyplot, Keyform and Keylogo. Keydraw costs £250 plus VAT. Telephone: 01-650 2999.

CFACC

LOGICAL STEP LTD's popular integrated accounts package CFACC — Computerised Financial Accounts — already runs on any CP/M, CP/M-86 or MS-DOS micro. Now it is going to a wider market in alternative language versions. The first of these are Arabic and German. In addition CFACC is now available to run under the Unix operating system.

Contact Janet Webberley, Logical Step Ltd, Wellesbourne House, Walton Road, Wellesbourne, Warwickshire CV35 9RH. Telephone: (0789) 842082.

More and more for the 64

- Audiogenic has announced Magpie, a powerful new menu-driven database for the Commodore 64. It comes on a cartridge, like Audiogenic's Wordcraft 40 to which it links. It costs £99.95. Application modules to follow will be priced from £19.95, and include accounts, mailing list, records and invoicing. More information from Audiogenic. Telephone: 01-290 6044.

- New games for the Commodore 64 include Gridtrap 64, Jumping Jack 64 and Triad 64 from Sumlock; Dancing Feats, Mothership, Planet of Death, Inca Curse, Ship of Doom, Espionage Island and Golden Apple from the well known Spectrum house Artic Computing; Sting 64 and Boog-a-Boo (The Flea) from Quicksilva; and Hideous Bill and the Gi-Gants from Virgin. Jumping Jack is a version of Frogger — not the same as Jumping Jak for the Spectrum, alias Leggit for the Atari. The Sumlock Games are £8.95 each, and all the others are £6.95 each. Contact Sumlock on 061-834 4233; Artic on (0401) 43553; Quicksilva on (0703) 37497; Virgin Games on 01-221 7535.

- Those struggling with the pathetic Basic 2 built into the Commodore 64, or the bugs in Simon's Basic, might like to try the BC-Basic Toolkit from Kuma. This 9K Basic extension cartridge adds over 97 new or modified commands, including 17 sound commands. It costs £57.50 including VAT. Telephone: (07357) 4335.

- Oxford Computer Systems can now supply a range of compilers for the Commodore 64. The Integer Basic compiler costs £125, and the Pascal compiler costs £49.95. Two cross-compilers, Portspeed and X-64, allow code to be compiled on Commodore 8000-series micros for running on the Commodore 64. Telephone: (0993) 812700.

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Yours faithfully,

David Brown.

DAVID BROWN,
MANAGING DIRECTOR

P.S. DMS+ works on virtually any microcomputer. If you want to know more about DMS+ for your own use, ring Compsoft on Guildford (0483) 898545 and they'll send you a complete full colour guide.

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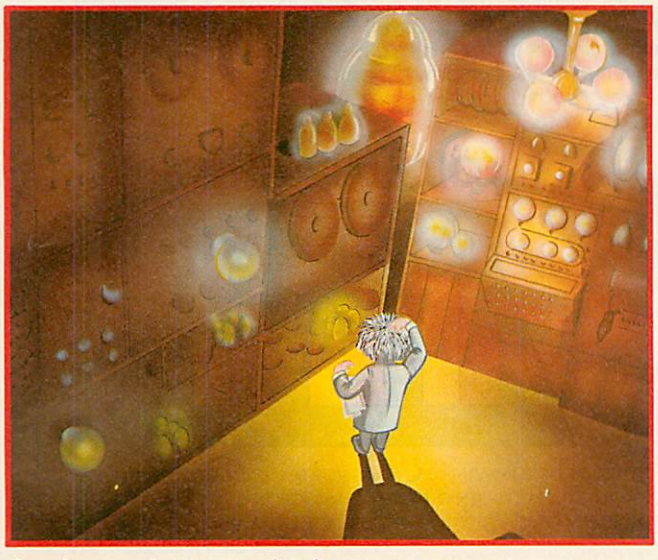
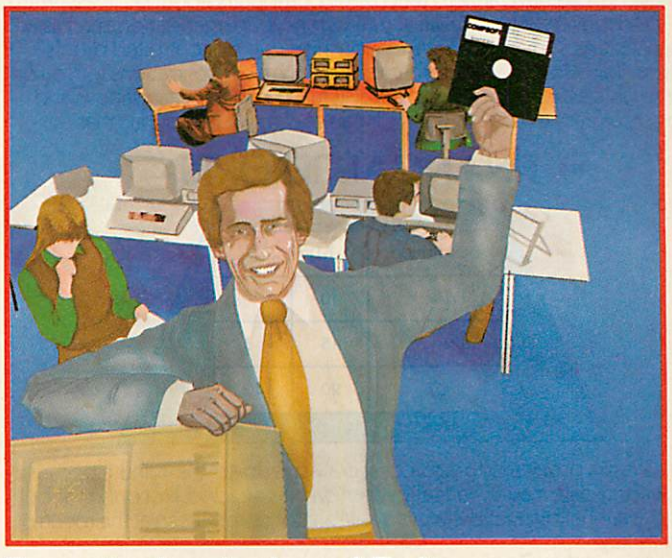


And man's knowledge was vast. – And so were his problems. But he was no nearer solving them ...



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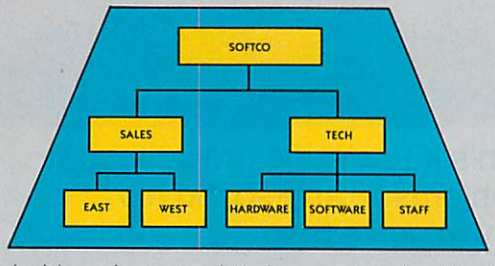

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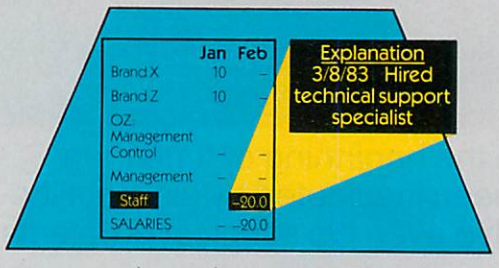

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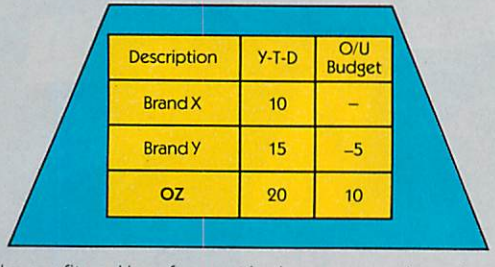

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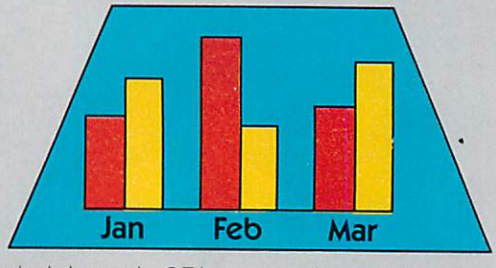

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by Ray Coles

The 6502 life preserver

Now this good old eight-bit workhorse has a compatible 16-bit successor.

THE 6502 microprocessor used in the Pet, Apple, Oric, BBC and many other microcomputers is about to gain a new lease of life which may see it survive to the end of the decade.

Based on the architecture and instruction set of the less successful Motorola 6800, the 6502 was tailored to the needs of personal-computer and video-game designers. It has achieved phenomenal success because of its suitability for handling high-level languages such as Basic.

Compared with its main competitor, the Zilog Z-80, the 6502 has a primitive architecture with fewer registers and instructions, and a slower clock. Yet thanks to the provision of a pipelined Fetch/Execute CPU and the inclusion of some crafty addressing modes, the 6502 often shows up better than its rival when running Basic Benchmarks.

Success

Despite this success, the 6502 seems to have reached the end of the road. While Intel, Motorola and Zilog have gone on to introduce 16-bit successors to their 8080, 6800 and Z-80, there has been a lack of 16-bit progeny from the 6502. As a result microcomputer manufacturers, including those with a historical loyalty to the 6502, are desperately trying to get 16-bit goodies proffered by the other manufacturers. Even Apple has now adopted the 68000 chip from Motorla for its flagship the Lisa.

One often-heard explanation for this lack of a successor is that the 68000 provides a perfectly good upgrade route, and so there is no real need for a 6502-like 16-bit processor. This assumes that all 16-bit processors are necessarily so different from their eight-bit ancestors that there is nothing to be gained by staying with a single line of evolution since the board design and the software will have to change anyway.

Non-compatible

This line of reasoning was followed by Zilog when the company introduced the Z-8000, which is non-compatible with the Z-80. Although the Z-8000 is regarded as a superb processor technically, it is now an embarrassing flop because it lacks an eight-bit bus version and is unable to run any Z-80 software. Thus Zilog has had to start again with the 16-bit Z-800, which will run Z-80 code. On the other hand, Intel retained a measure of 8080 compatibility with its 8086 and, perhaps as a result, this less powerful 16-bit device has swept the board.

Having watched this shake-out in the 16-bit market, a group of engineers working at the Western Design Center based in Tempe, Arizona decided that there must be a potential market for a 6502-compatible 16-bit processor. As a result they have designed the most compatible 16-bit successor to emerge yet, the W65SC816.

In spite of its late entry into the market, it seems likely that the W65SC816 will find a lot of willing sockets. Many writers of 6502 software will be relieved to discover that their investment will not be rendered obsolete, and many personal-computer designers will welcome this straightforward route to higher performance.

Code unchanged

Compatibility is the keyword of the W65SC816 design. It will be possible to run 6502 code unaltered on the new chip, but what is more remarkable is that the W65SC816 uses the same pin connections as its ancestor, which means that it can, in theory, be used as a drop-in upgrade for systems already in production but presently using the 6502.

In spite of all this eight-bit compatibility, there really is a 16-bit processor lurking inside the package, ready to provide greatly increased performance when unlocked by the programmer or the system designer. Although the W65SC816 retains an eight-bit external data bus like the 6502, inside the package a 16-bit bus is provided to increase throughput. Memory-addressing range has been increased from 64K to a more respectable 16Mbyte, because of the provision of an additional eight address bits which act as bank selects.

The puny eight-bit register set of the 6502 has been extended so that all registers are at least 16 bits long, with the program counter and index registers being extended to a total of 24 bits each by concatenation of the two new eight-bit program bank and data bank registers respectively. Like the 6502, the W65SC816 has a pipelined Fetch/Execute architecture, and like other 16-bit processors with an eight-bit data bus such as the Intel 8088, the processor retrieves 16-bit data by the use of two successive Fetches. Unlike other 16-bit processors however, the W65SC816 Fetches the low byte first and starts to act upon it even before the second byte has been Fetched. This simple pipeline approach is made more effective by the retention of eight-bit op codes for all instructions.

To use the new chip to run unmodified 6502 code, the programmer has only to set the new E flag bit to a 1. While this flag is set the W65SC816 performs like a 6502 with the same clock timing, instruction cycles, and other features such as effective register length. When the E flag is reset, new 16-bit code can be executed to provide the higher speeds and greater memory-addressing range that is normally associated with the 16-bit processors from other manufacturers.

In the 16-bit mode, the facilities of a memory manager become available — facilities which on other 16-bit processors usually require the use of an external MMU chip. Even in eight-bit mode this chip will outperform a standard 6502, thanks to a 4MHz clock rate.

Licensing

One surprising feature of the W65SC816 is that the chip designers will not make it themselves. Instead, they plan to license the design to other manufacturers and to use the so-called silicon foundries to produce it for them. One of the first suppliers of this device will be GTE Microcircuits, but do not be surprised to see other traditional 6502 suppliers such as the CBM Semiconductor Group, Rockwell and Synertek join the 16-bit 6502 bandwagon before long.

The W65SC816 chip is currently available only in sample form, but already its undoubted attractions are becoming evident to existing 6502 system designers. No doubt there will be a big demand. Production chips will be fairly easy to make due to the conservative technology selected by the Western Design Center. We should not have to wait too long before all 6502 fans can take advantage of the easiest route yet developed to compatible 16-bit processing.

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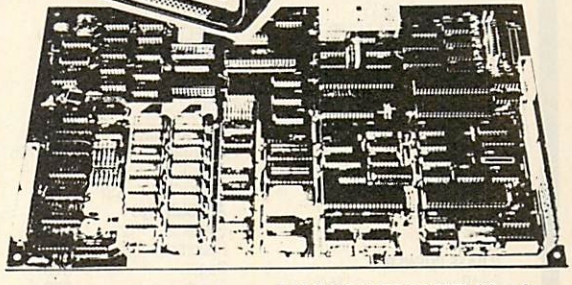

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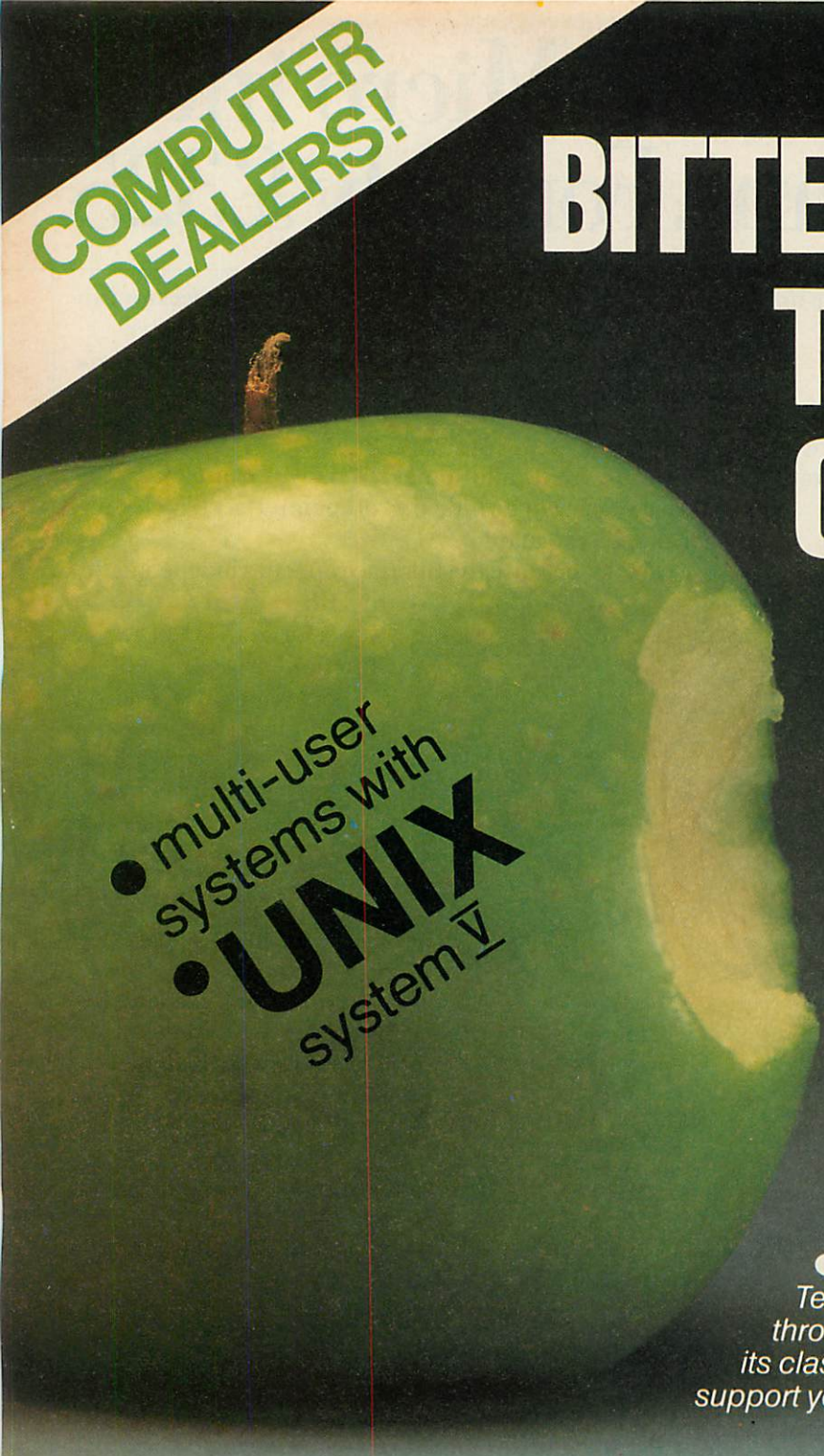

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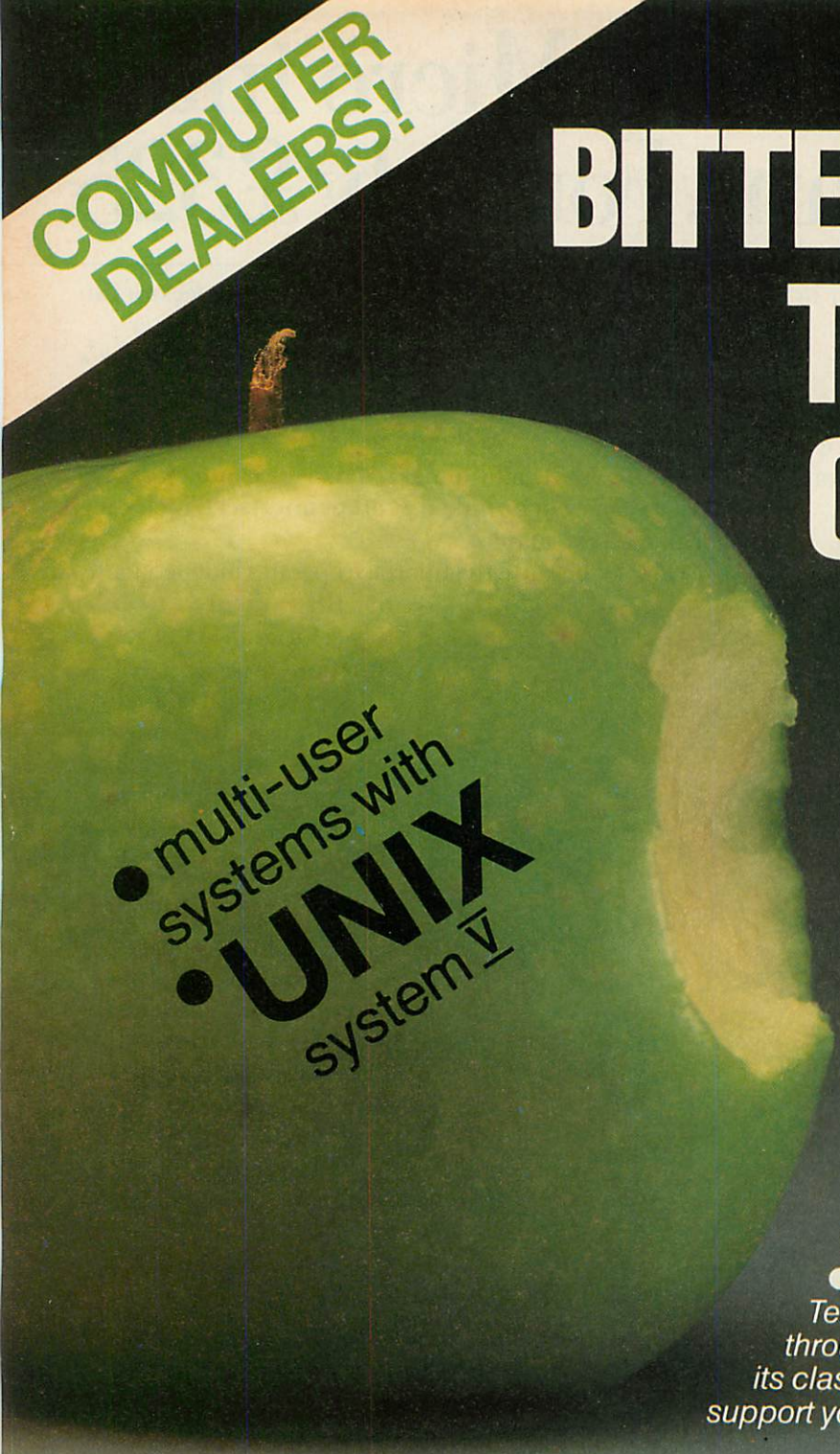

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by Mike Lewis

Two at a time

How to achieve multi-tasking with even the most modest machine.

WOULDN'T IT be nice if your computer could do several things at the same time; if you could enter data for one program while printing the results of the previous one, for example. If you can afford a 16-bit processor with around 256K of RAM this is no great problem. You buy a multi-tasking operating system like Concurrent CP/M or MS-DOS 2, and you are in business.

But if yours is a more modest machine or you have a more restricted budget you can still achieve a degree of simultaneity. Moreover the technique can be handled in high-level languages like Basic, and while some careful programming is needed, you will not need to delve into the operating system or hardware.

In-built delay

The trick is to take advantage of the delay that occurs whenever the program is waiting for input from the operator. Even the fastest typist needs a few hundred milliseconds to hit a key, and the program can use this time to do something else.

Suppose you have a large table holding the names and addresses of several hundred customers and you want to be able to print address labels for any specified customer. The operator must be able to type in the customer's surname, at which point the program searches for the required table entry, does some editing on it, then prints it.

This process could be speeded up if the program could deal with one customer at the same time as the user was typing in the name of the next one. To do this, you need to think of the program in two parts. First, there must be a keyboard-handling routine that collects characters from the console and stores them in a holding area. Secondly, there is the main processing loop. It must be able to take an entry from the holding buffer each time it is ready to process the next item of data.

Status test

At the heart of the keyboard routine is an instruction for testing the status of the console. Many high-level language implementations have this feature. For example, Microsoft Basic uses the Inkey$ function, as shown on lines 9020 and 9090 of the listing. It returns the value of the last key that was hit, or a null string if no key was pressed since the previous call to Inkey$.

In CBasic and CB-80, you would use Constat% and Conchar% returns the value of the key. In some versions of C, there is a similar function called KBHit(). Check your manual for other languages and versions.

Two points need watching. In some implementations, the keyboard-testing function echoes the entered character to the screen; in others you have to do this yourself. Microsoft Basic is one of the latter kind, and this is the reason for the Print statement in line 9030. Secondly, make sure that the function does not suspend the program if no key has been hit. Thus, Microsoft's Input and Applesoft's Get would both be unacceptable here.

As soon as the keyboard-handling routine is called, it tests the keyboard status and exits if no key has been pressed. In the sample listing, this is handled by the While-Wend loop starting in line 9030. This is preferable to a Goto because it allows you to put another keyboard test at the foot of the loop.

Once the routine detects a keystroke it checks to see if it represents a printable ASCII character, as opposed to a cursor key, tab, line feed, etc. If it is a printable character, the routine echoes it and adds it to the end of a string that represents the current entry. If the key is a Backspace or a Delete, the previous character is dropped from the string and erased from the screen.

When the operator presses the Return key, the program treats the current entry as complete. It stores the string in the next free entry of the holding area and clears the input string ready for the next entry. This action is also carried out if the string exceeds a pre-specified length.

The main part of the program handles the actual processing of the data entered by the user. In the example this would search the main name and address table, edit the required entry and print it.

The important point is that the main program loop must be liberally sprinkled with calls to the keyboard routine — using Gosub 9000 in the example. The exact position of these calls is not critical, but ideally they should be executed at the rate of about 10 per second. When the main program requires an entry for processing, it gets the next one from the buffer. If there is no entry waiting, the program loops until one arrives — see line 350.

Extra functions

The good thing about this scheme is that the mechanics of the input routine are independent of the main program. You could rewrite the input module, adding cursor-control and editing functions perhaps, without any effect on the overall logic. By the same token, the fact that the sample program expects a null entry to signal the end of the session is of no concern to the input routine.

The input buffer in the sample program is a 25-entry array, allowing up to 24 entries to be waiting at any one time. The array is a

(continued on next page)

Fast table look-up

It appears to be a law of programming that however simple and efficient a piece of coding may be, there is always some way of improving it. Take the method described in February's *Practical Computing* for searching an unordered table. The linear search method that was described can be summed up as follows:

- Look at the next table entry.
- If it is the one you want, Stop.
- Otherwise, repeat until you reach the end of the table.

In Basic, this would be coded as an If statement within a For-Next loop.

A faster method is to start by storing a copy of the searched-for value in an extra slot at the end of the table. You then look at each item in the table until you reach the one you want. You can rely on always getting a Hit before you fall off the end of the table, so you no longer need to check for this.

You end by checking the subscript of the found value. If it points to the final entry in the table, then the search has failed because you have found the dummy value. In contrast to the previous method, here you only need to do this test once, at the end of the search.

In Basic, the routine would look as follows — assume you are searching for Key$ in an array Table$(N + 1), which contains N values

```
J% = 1
TABLE$(N + 1) = KEY$
WHILE TABLE$(J%) < > KEY$
  J% = J% + 1
WEND
IF J% < = N THEN hit ELSE miss
```

This is considerably faster than the original linear search. Using the old method, I timed a search for the 500th element of a 1,000-entry table at 4.2 seconds in interpreted Basic. This new method took 2.3 seconds.

(continued from previous page)

circular one, with the first entry being stored and processed immediately after the last. This is handled by the Mod function in lines 370 and 9070, which calculates the modulus or remainder of an integer division. In this way, the subscripts into the array — Dothis% and Replied% — never have to click back to zero, which means that they never get out of sequence.

The printing of the Backspace/Space/Backspace string in line 9050 is the only reliable hardware-independent method of backspacing and erasing a character from the screen. On many terminals, issuing a Delete character does not have this effect. Note too the single Print statement in line 9080. It advances the cursor to the start of the next line, thus echoing the user's Return key. This type of feedback is an important feature of any interactive system.

Alternative

There is another approach that does not involve programming. This is spooling, a term which goes back to the days when a mainframe computer would send a print-out to a spool of tape for later printing at a more convenient time.

The easiest way to set up spooling is to use the CP/M extension package produced by FBN Software. It includes a program called Spool, which can be resident while any application program is running. Spool will intercept the output that the application program tries to send to the printer, and write it to a disc file of your choice.

When you are ready to commit the printout to paper you use another program in the FBN package, called Unspool. Like the sample program, Unspool uses the keyboard waiting time to do the actual printing.

Using Spool and Unspool together you could, for instance, print one batch of invoices while entering data for the next. The beauty of it is that you can use this method with virtually any CP/M program, and no patching is necessary. It is superior to Digital Research's Despool program, which handles the simultaneous printing but not the intercepting of the original output.

There is a minor snag. Unspool occasionally needs to talk to the operator, mainly to get the names of disc files. The resulting messages could spoil the appearance of the screen if it has already been nicely formatted by the application program.

But if you can live with this small difficulty, you will find the FBN package a useful productivity booster. It also has a Submit-type utility that allows you to enter several commands on the same line, and a program for recovering erased disc files. It is available from Transam Microsystems, 59 Theobalds Road, London WC1; telephone 01-404 4554. The cost is £45 plus VAT.

```
10 '          Program to demonstrate simultaneous keyboard entry and printing
30 '    Variables used:
40            MAXK%=25          'Max. number of keyboard entries waiting to
                                 be processed
50            BACK$=CHR$(8)     'Backspace key
60            DEL$=CHR$(127)    'Delete key
70            RTN$=CHR$(13)     'Carriage-return key
80            REPLIED%=0        'Actual number of keyboard entries this session
90            DOTHIS%=0         'Points to next entry to be processed
100           ENTRY$=""         'The current string being entered
110           MAXLEN%=80        'Max. length of an entry
140 '
150           DIM ENTRIES$(MAXK%)      'This array will hold the entries
                                        waiting to be processed
200 '
220 '         Program initialisation goes here
240 '
310     PRINT "Please enter required name; to finish, just press RTN"
330 '
340 '         Main loop starts here
350     WHILE DOTHIS%=REPLIED%:
              GOSUB 9000:
        WEND                           'Keep getting keystrokes until there is
                                        at least one entry waiting
360 '
370     THISENTRY$=ENTRIES$(DOTHIS% MOD MAXK%)
                                       'THISENTRY$ contains the entry to be
                                        processed next
380     IF THISENTRY$="" THEN
              PRINT "Finished": END    'If empty, end the run
390     GOSUB 9000                     'Get keystrokes
400     GOSUB 2000                     'Perform search of main table
410     GOSUB 9000
420     GOSUB 3000                     'Edit the target name
430     GOSUB 9000
440     GOSUB 4000                     'And print it
450     GOSUB 9000
460 '
470 '         The subroutine calls in the previous eight lines could
              perform any appropriate function. But they must be liberally
              interspersed with calls to the routine that gets keystrokes.
480 '
500     DOTHIS%=DOTHIS%+1              'Increment pointer
510     GOTO 350                       'and loop back for next entry
530 '
2000 '        The subroutines that perform the main parts of the
3000 '        program would go here. (Table searching, editing  and
4000 '        printing in the present example.)
5000 '
9000 '        This is the keyboard handling routine
9020    CHAR$=INKEY$                   'Test keyboard status and get character
9030    WHILE CHAR$<>"":
              IF CHAR$>=" " AND CHAR$<="~" THEN
                    ENTRY$=ENTRY$+CHAR$: PRINT CHAR$ ; : GOTO 9090
9040                                   'If printable character, add it to
                                        the current entry and echo it
9050          IF (CHAR$=BACK$ OR CHAR$=DEL$) AND LEN(ENTRY$)>0 THEN
                    ENTRY$=LEFT$(ENTRY$,LEN(ENTRY$)-1):
                    PRINT BACK$+" "+BACK$ ; : GOTO 9090
9060                                   'If backspace or delete, remove it from
                                        entry and from screen
9070          IF CHAR$=RTN$ OR LEN(ENTRY$)>=MAXLEN% THEN
                    PRINT: ENTRIES$(REPLIED% MOD MAXK%)=ENTRY$:
                    ENTRY$="": REPLIED%=REPLIED%+1
9080                                   'If RTN or string too long, add the
                                        entry to the table, reset it for next
                                        time, and increment the pointer
9090          CHAR$=INKEY$:
        WEND
9100 RETURN
```

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Maximising

The British computer industry is small when judged by international standards. Two large American companies control 90% of world markets. They can do this because their products represent the standard by which others are judged. When these standards are accepted by the marketplace they have the effect of stabilising the technology. Thus CP/M is accepted as the industry standard operating system for 8 bit processors, and subsequent computer development has employed this standard, with the dual effect of making both man and machine portable. Operators can use different computers, with CP/M, and software can be switched from machine to machine. For the end user the emergence of

technology

these standards is critical because they allow him to experiment with the technology without risk of entering blind alleys where systems and products disappear. In order to avoid this situation Memotech has employed these standards within the MTX Series.

In the UK there has been such rapid development in microsystems that in many cases users have been seduced by the technology rather than the standards they should be following. In educational and business applications the need for continuity is obvious. This is accentuated by the development of database technology, where very large information files are accumulated, the primary expense being the input of data. Companies and schools will not relish the idea of trying to rescue data when the standard 32 bit machines appear in two years time.

There has been a tendency for manufacturers to launch machines which are still on the drawing board, and for which no software standards exist. CP/M 80, the industry standard micro operating system, supports tens of thousands of commercially available software packages. IBM take the view that things should be done properly and *then* released to the user. This is a well tried and clearly well tested premise which Memotech has implemented in the MTX series.

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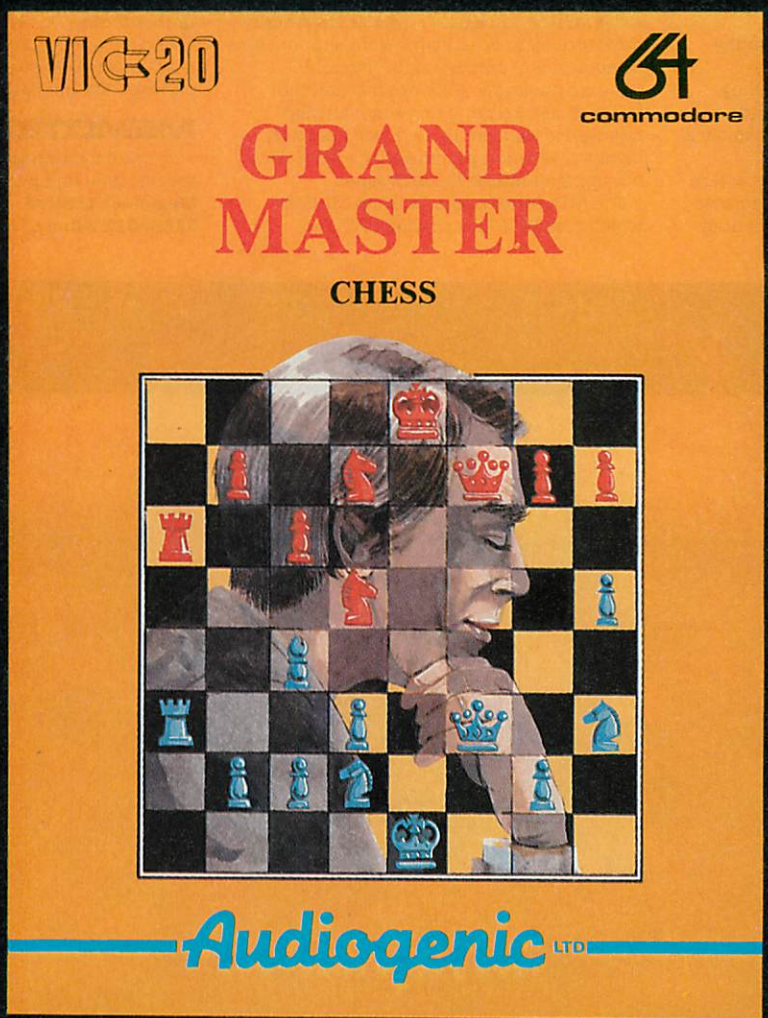

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```
INVOICE                                   <0>############
To  #<1>############                  From: G. W. Ltd
    #<2>##################                  55 Bedford Court Mans.
    #<3>##################                  Bedford Avenue
    #<4>############                      London W.C.1.
    #<5>########                        Tel: 01-636-8210

Date<6>##,##        Tax point<7>##,##        Agent<8>###

Quantity  Description                    Cost     Tax      Total
<9>###  <10>###############   <11>##   <12>##   <13>###
<14>##  <15>###############   <16>##   <17>##   <18>###
and so on
          Total....<19>#######              Tax....<20>####
```

<??> items <1> to <5> internal command to request name, input, and then search an address file for details.
<??> items <6> to <7> request date input and validate.
<??> item <8> request agent number and validate range.
<??> item <9> request quantity, validate range.
<??> item <10> request description, search file, accept, and calculate fields <11> <12> <13>. if finished invoice then calculate fields <19> and <20>

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Then send fields <9> , <10> , <11> to product analysis file.
Then send fields <0>, <1>, <7>, <19>, <20> to V.A.T. file.
Then send fields <10> , <11>, <12>, <13> to Nominal ledger. Do you see?

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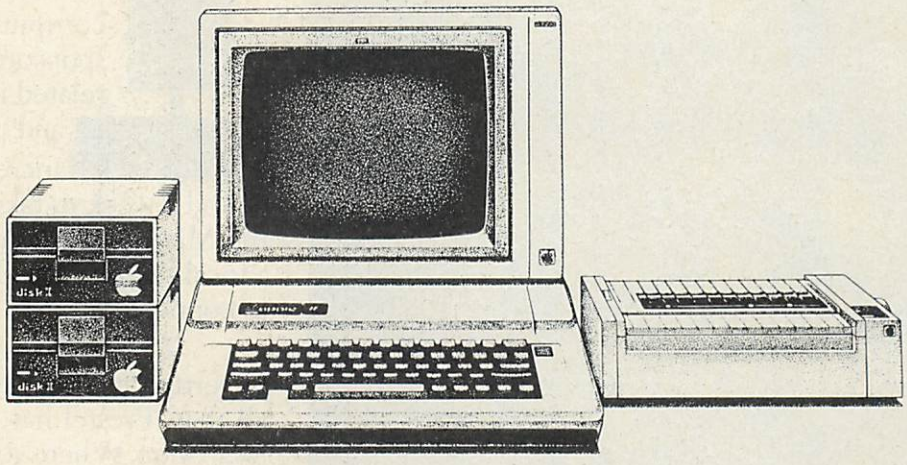

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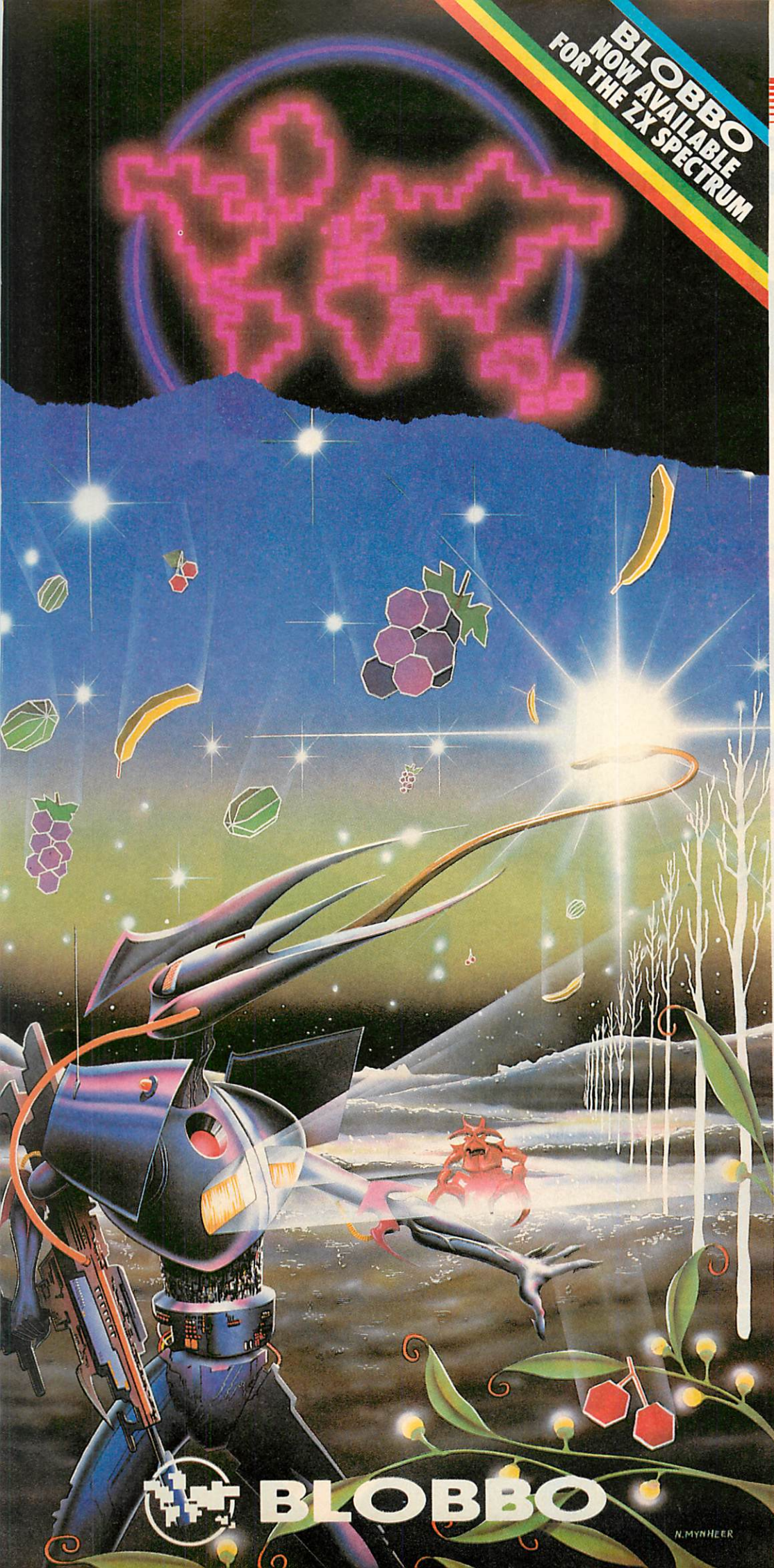

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Run at high speed around the maze collecting **treasure** and **fruit** worth bonus points – but don't get caught by the **Blobbo-eaters**! Tactical dodging must be employed to avoid them. If you're caught or step on a skull and crossbones you lose one of your three lives.

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Move **Knuckles** around his maze, using a joystick to kick **Roks** and **Magic Squares**. The object is to line up the Magic Squares, using the fire key, and so advance to the next level, gaining a level bonus.

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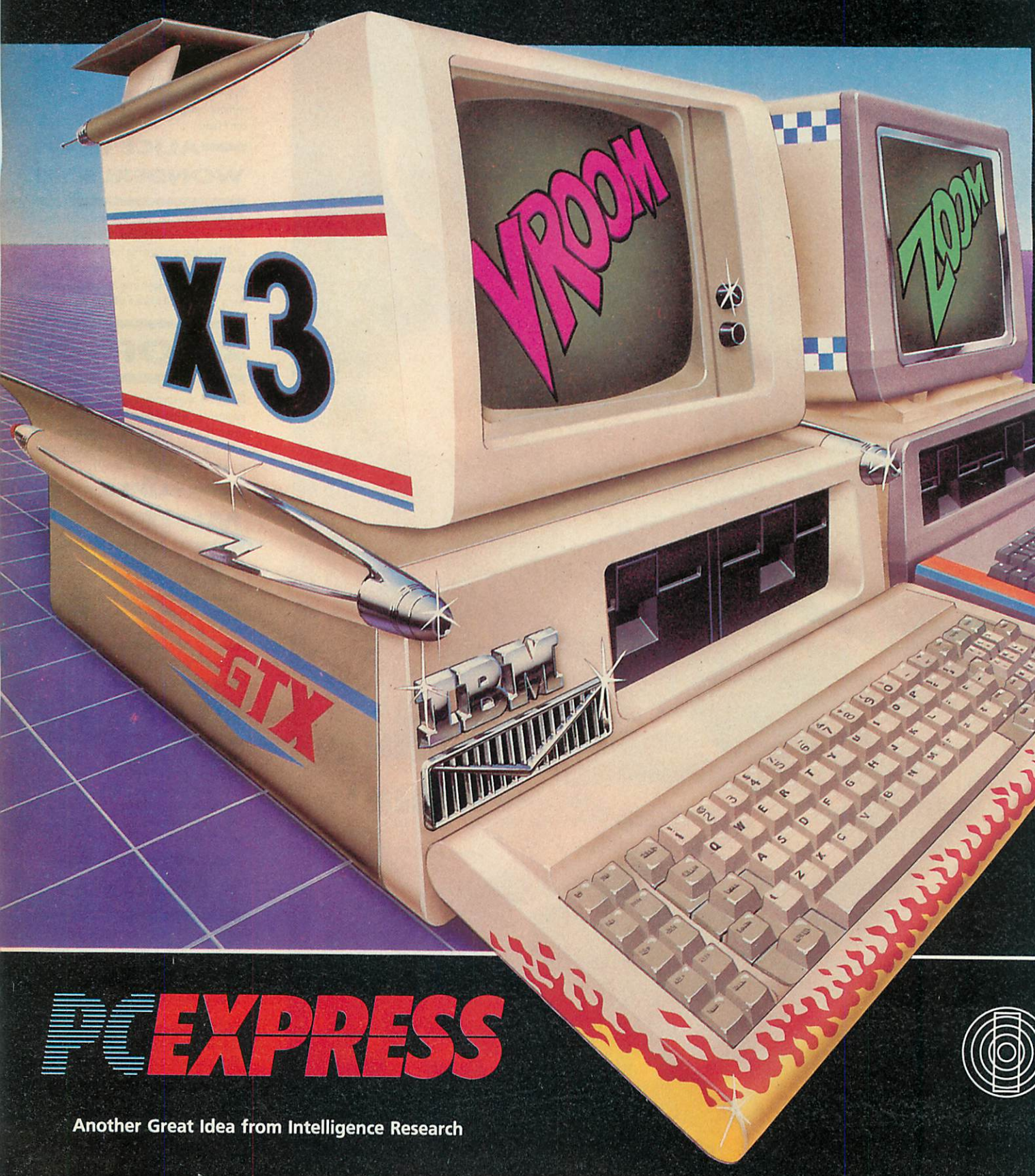

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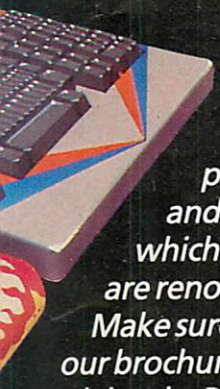

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Keep on rolling

THE STEAM-ROLLER shows no sign of losing momentum. IBM profits for 1983 are up 24.1 percent at $5.5 billion. Turnover is up 17 percent to $40.2 billion, which is the equivalent of 70 million BBC Model Bs at retail prices, or 1,350,000 Sinclair QLs per week. Chairman John Opel is said to be quietly optimistic for 1984.

Our estimate is that IBM has delivered around a million IBM PCs so far: 800,000 or so in the U.S. and another 200,000 mainly in Europe. The number could increase to around 1.5 million deliveries in 1984. There will also be the 3270PC, XT/370 and forthcoming 80186-based Popcorn multi-user models to add to this figure. However, it now looks unlikely that anything like a million PCjrs will be delivered, due to the shortage of Intel 8088 chips.

For 1985, the American market research firm Future Computing Inc. estimates that the Fortune 2,000 companies in the U.S. will spend $12.1 billion on personal computers, and estimates that 60 percent will be IBM PCs — around 2.5 million machines. In a survey of these firms, either the IBM PC or the XT was first choice on 67 percent of replies.

However, another market research company, International Resource Development Inc., warns that several Taiwanese firms are about to flood world markets with look-alike and fake copies of the IBM PC. Taiwan firm Mycomp already has a PC clone, with Multitech and Mitac poised to enter the look-alike market. This might offer some relief to Apple, whose products are currently the most frequently copied. IRD also speculates that IBM will go to the Far East for the manufacture of its own forthcoming portable model.

Meanwhile IBM is extending the huge success of its Japanese-made 5550 model of the PC. IBM has adopted the Dragon input system, developed by Taiwanese inventor Chu Bang-Fu after eight years of research. This is able to input directly more than 20,000 Chinese characters via the standard QWERTY keyboard.

Though the IBM model stores only 11,000 Chinese characters on a disc, this is expected to give IBM a huge advantage in the Chinese-speaking market. So far applications software is limited to a Chinese version of Microsoft's Multiplan spreadsheet. And yes, it does run under MS-DOS.

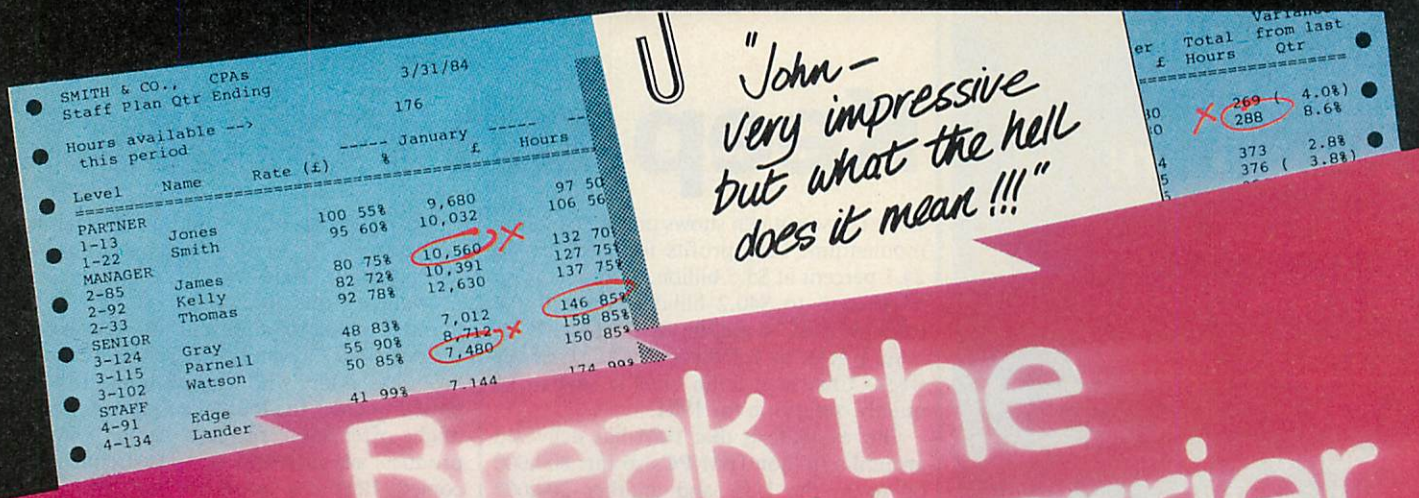
PC Terminal

SANTA CLARA SYSTEMS of San Jose has launched the first IBMulator with a built-in local area network. The PCTerminal has its own 8088 chip and 64K of RAM, but no disc storage, though there is a port for connecting a 5.25in. floppy. The software, PCNet, enables up to 16 PCTerminals to be connected to one IBM PC or XT. Each PCTerminal picks a PC or XT and shares its peripherals. This enables a PC network to be put together for relatively little cost.

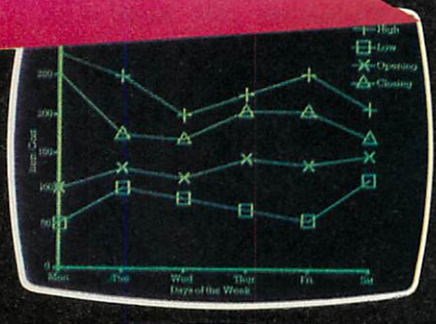
PCTerminal runs under PC-DOS or the Santa Clara version of MS-DOS, called SCS-DOS. Each PCTerminal costs $1,295.

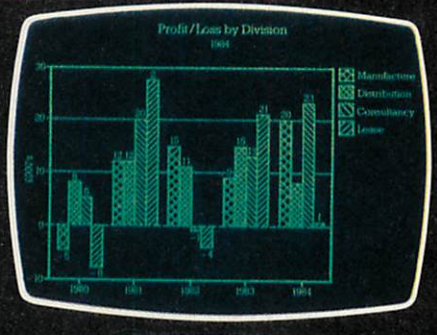
Also from SCS comes a disc-cache system, Quick Disk, of which there are five models with from 128K to 1Mbyte of RAM.

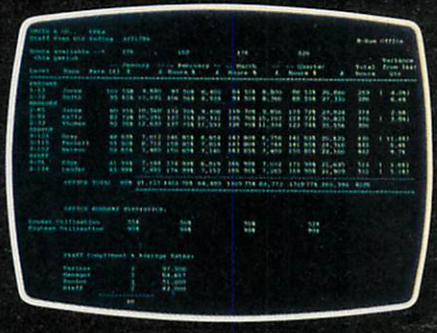
Contact Santa Clara Systems, 1860 Hartog Drive, San Jose, California 95131, U.S.A. Telephone: (area code 408) 287-4640.

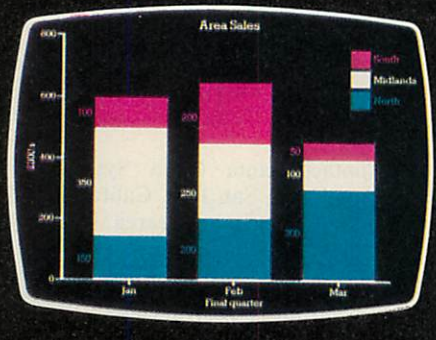


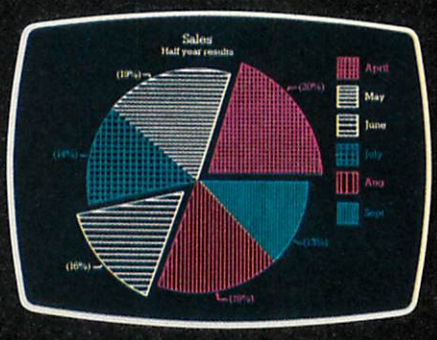
Break the 'language' barrier

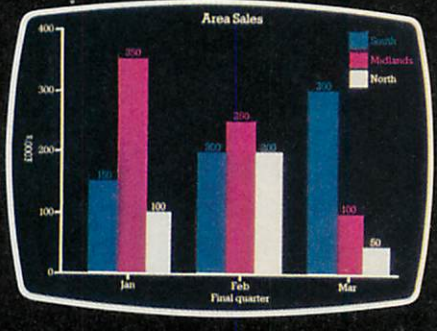












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And now...PC/IX

SOME PEOPLE have supposed IBM to be antipathetic to the Unix operating system simply because it is produced by its so-called rival AT&T, which owns Bell Labs. But now that software house Interactive has managed the amazing feat of implementing Unix on the 8086 chip — with which the PC's 8088 is compatible — IBM has adopted it as PC/IX. The initials stand for personal computer interactive executive. The new operating system goes on sale in the U.S. this April at $900. No U.K. launch date has been announced.

PC/IX is the System III brand of Unix, not the newest System V, though most implementations still seem to be running version 7 of System II.

It is not certain how this will affect the Microsoft implementation of Unix, which is called Xenix. However, continuing support for the PC-DOS verison of MS-DOS as the main IBM PC operating system looks assured.

AT&T is supposed to be introducing its own range of desk-top micros later this year. It would be very surprising if these did not also come with Unix.

Inner Product

IBM PC dealer Inner Product has developed some interesting software for the PC, including Viewcom. It provides access to Prestel and viewdata systems from Basic or APL programs, and presents two Prestel pages on screen at the same time. Viewcom will also transmit pages if you are an information provider. Of course, you also need a modem and asynch communications facilities.

IP supplies APL*Plus/PC with a set of free keycaps engraved with APL characters to fit the IBM keyboard. In addition, there is software to transfer data between dBase II and APL, and between Multiplan and APL. The Multiplan/APL interface will also move files between WordStar and APL.

Contact Inner Product, Eagle House, 73 Clapham Common South Side, London SW4 9DG. Telephone: 01-673 4047.

Hardware shorts

● **An 18Mbyte** tape back-up streamer has been launched by Davong. It claims to copy a 15Mbyte hard disc in four minutes. Phone Davong in Sunnyvale, California, U.S.A. (area code 408) 734-4900.

● **A magnetic** strip reader for the IBM PC is available from Pete & Pam, if you want to read the strip on the back of someone's credit card. Telephone: (0706) 212321.

● **Alloy** can also supply a credit-card reader, called PC-Card, which attaches directly to the PC keyboard. Telephone: (0285) 68709.

● **Digithurst's** well known image analysis system is now available for the IBM PC. Microscale II comes with a vision interface, software, documentation and choice of camera. Contact Digithurst Ltd at Royston (0223) 208926.

● **3D Digital Systems** has announced Inlab and Thinklab for the IBM PC. Both are Eurocard units for laboratory use, for data acquisition and control. Telephone: 01-387 7388.

Leading Edge

THE HUMAN EDGE Software Corporation of Palo Alto, California, is introducing a range of products classified as business strategy software. Packages are the Communication Edge, Leadership Edge and The Sales Edge. These packages claim to "build your personal power", because "personal power is the way to make your mark."

First package to reach the U.K. is The Sales Edge, which assesses your character and the character of the person you are selling to, gives advice, and tells you how to close the deal.

As well as running on the IBM PC, all the packages are promised for Apple's new Macintosh.

To contact Marketing Software telephone 01-731 3083.

APL*Plus 3.0

APL*PLUS/PC has been released in a new version for the IBM PC. A complete APL v3.0 kit costs £600, but existing users can upgrade for £105.

Meanwhile APL*Plus has relocated from London to Birmingham. The new address is Aston Science Park, Love Lane, Birmingham B7 4BJ. Telephone: 021-359 5096.

The Micro Technology Group of Tunbridge Wells has the British-designed Honeycomb cartridge disc-storage system to match the PC. It has two removable 10Mbyte discs, and costs £3,750. A single 10Mbyte version is available for £2,800. Cartridges are £65 each. Contact the Micro Technology Group, 51 The Pantiles, Tunbridge Wells, Kent. Telephone: (0892) 45433.

Software shorts

● **Peachtree's** talking software, known as Speachware, now works with the IBM PC. Main use so far is speaking demo programs for Peachtree products. Telephone: (0628) 32711.

● **The Mills and Allen** software system Combat, a computer-based authoring system based on the IBM PC, is now supplied exclusively by Datasolve Education, which is part of Thorn EMI. Datasolve also works with the Wicat and BBC Micros. Telephone: (09327) 85566.

● **Son of Incredible Jack** is Jack 2, and it is now on the IBM PC as well as the Apple. Sales of $1million are claimed for this integrated software product in its first two weeks on the market. Contact Business Solutions Inc. in New York at (area code 516) 269-1120 or, more likely, Pete & Pam will have it by now.

● **Workwriter** is an easy-to-use screen-orientated word processor for the IBM PC from Micro Research in Brussels, Belgium. Telephone: (02) 736 9040.

● **Softsel** have two new American packages, R:base from Microrim, and MAG/base from MAG Software. R:Base is Multiplan-compatible and costs £345. Contact Softsel at 01-844 2040.

● **Ncore** is an integrated spreadsheet, financial modeller and graphics program for the IBM PC. The price is £395 plus VAT. The distributor is Ferrari Software. Telephone: 01-751 5795.

● **Micro/Prophit** is a financial-modelling packge for PCs and look-alikes. It is available from Control Data. Telephone: 01-240 3400.

● **The Witness** is the latest Infocom game for Apple, Atari and other good computers. In it a cheap con-man tries to implicate a dead woman's millionaire husband. Pete & Pam has the IBM PC version for £33.95 plus VAT. Telephone: (0706) 212321. Probably the butler didn't do it.

A database by any other name

Paul Myerscough contrasts three information-management systems on his IBM PC.

ALL MAY NOT be what it seems when database systems are under discussion. The accepted definition depicts a store of data with a physical nature that is independent of how it appears to users and application programs. But users of the three systems reviewed here will find that applications often do impose constraints on file design. An alternative definition culled from the *Penguin Dictionary of Microprocessors* may be more appropriate: it describes a database as "any file which might sound more important if called a database".

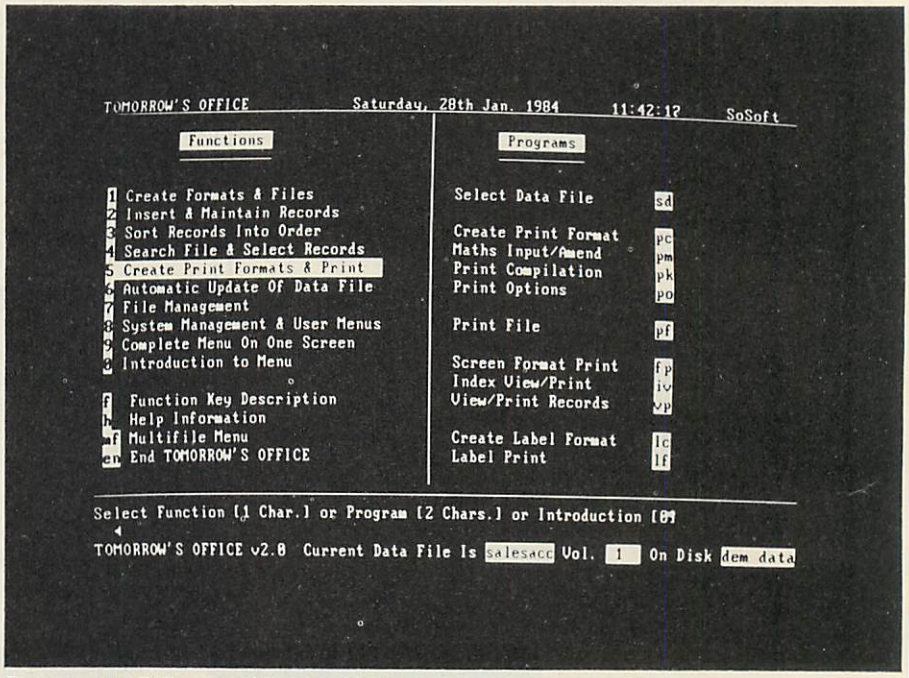
The names of two of these products are equally fanciful. Tomorrow's Office, far from being software of the future, is a dinosaur of a system. It is still growing, but how long can it survive? A life-line to the business micro user is the message implicit in the name "Rescue". But to reach the market it deserves this package is sadly in need of a rescue itself in the form of an injection of cash for development and marketing effort. Only Delta avoids serious criticism.

Custom-built

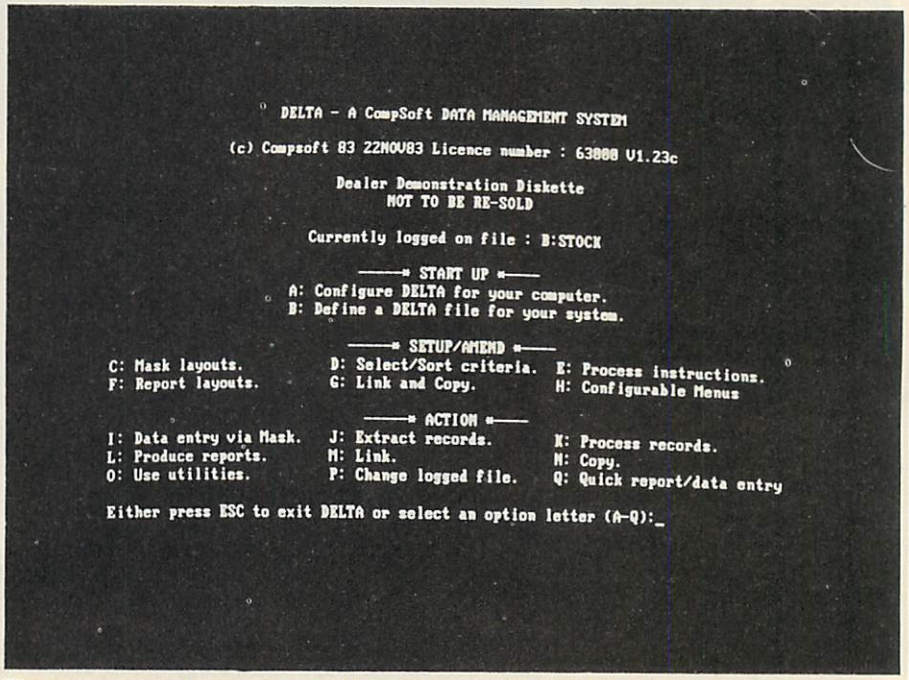
All three packages are designed to provide a quick and easy means to develop a custom-built system. Such a system would consist of a set of data files, user input and enquiry screens, procedures for extracting and sorting data, procedures for creating reports, and special menus from which these options may be controlled.

The manuals that accompany the software seem accurate and comprehensive. But they are all too wordy, and they are not well formatted for quick reference. Delta's comes out on top: at 236 pages it is the shortest, very easy to comprehend, and includes a good, confidence-building tutorial introduction. Rescue's 408-page manual is far too long and its organisation is eccentric, though an excellent index makes it easy to use; it needs a rewrite.

The most remarkable first impressions come from the form in which the software is delivered. While Rescue arrives on one floppy disc and Delta on two, Tomorrow's Office requires no less than nine. Over 2Mbyte of program code prompts thoughts



Tomorrow's Office provides sophisticated screen presentation.


DELTA - A CompSoft DATA MANAGEMENT SYSTEM
(c) Compsoft 83 22MOV83 Licence number : 63888 V1.23c
Dealer Demonstration Diskette
NOT TO BE RE-SOLD
Currently logged on file : B:STOCK
START UP
A: Configure DELTA for your computer.
B: Define a DELTA file for your system.
SETUP/AMEND
C: Mask layouts.
D: Select/Sort criteria.
E: Process instructions.
F: Report layouts.
G: Link and Copy.
H: Configurable Menus
ACTION
I: Data entry via Mask.
J: Extract records.
K: Process records.
L: Produce reports.
M: Link.
N: Copy.
O: Use utilities.
P: Change logged file.
Q: Quick report/data entry
Either press ESC to exit DELTA or select an option letter (A-Q):_

The option menus and many messages provided by Delta make it simple to use.

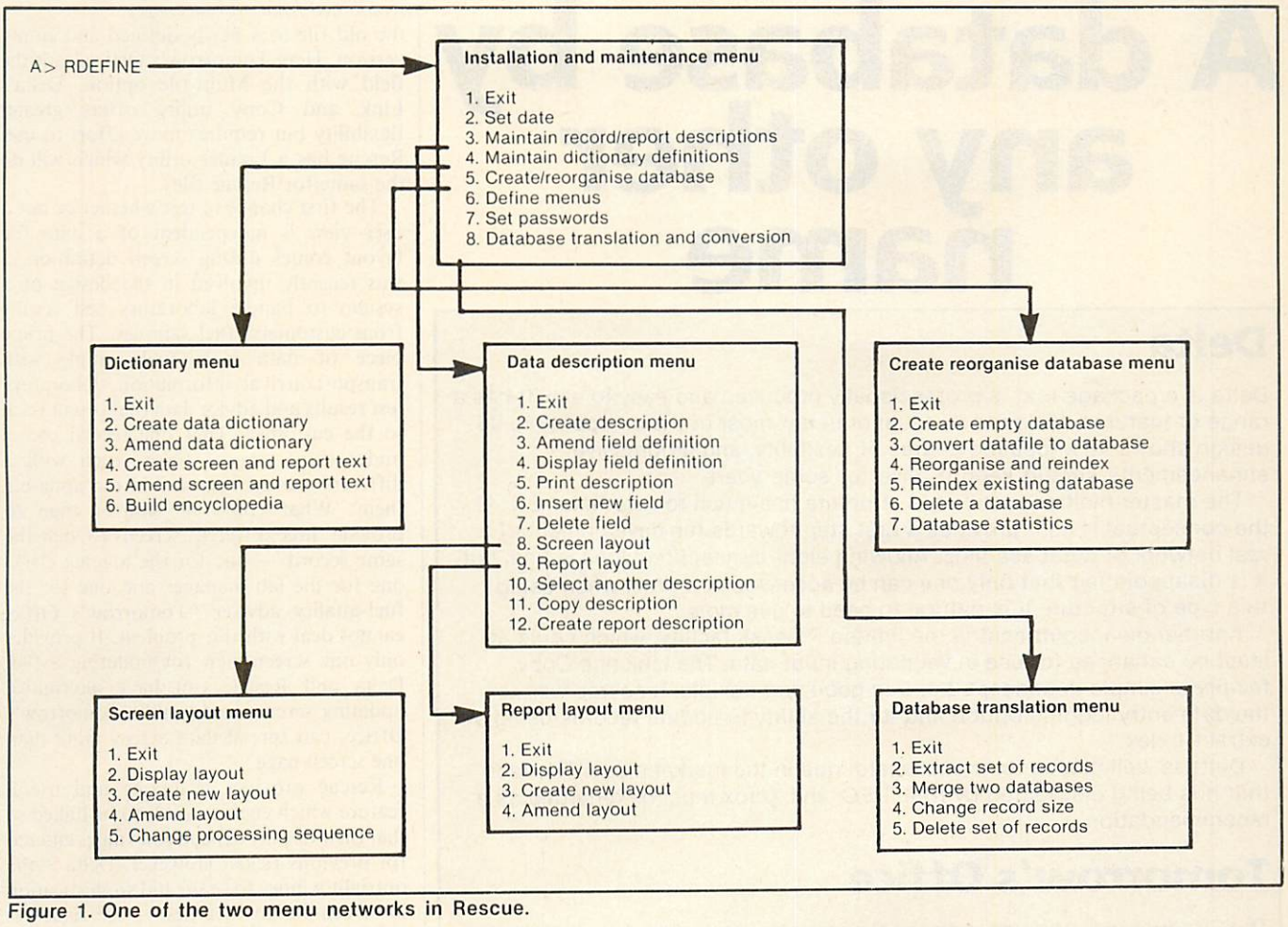
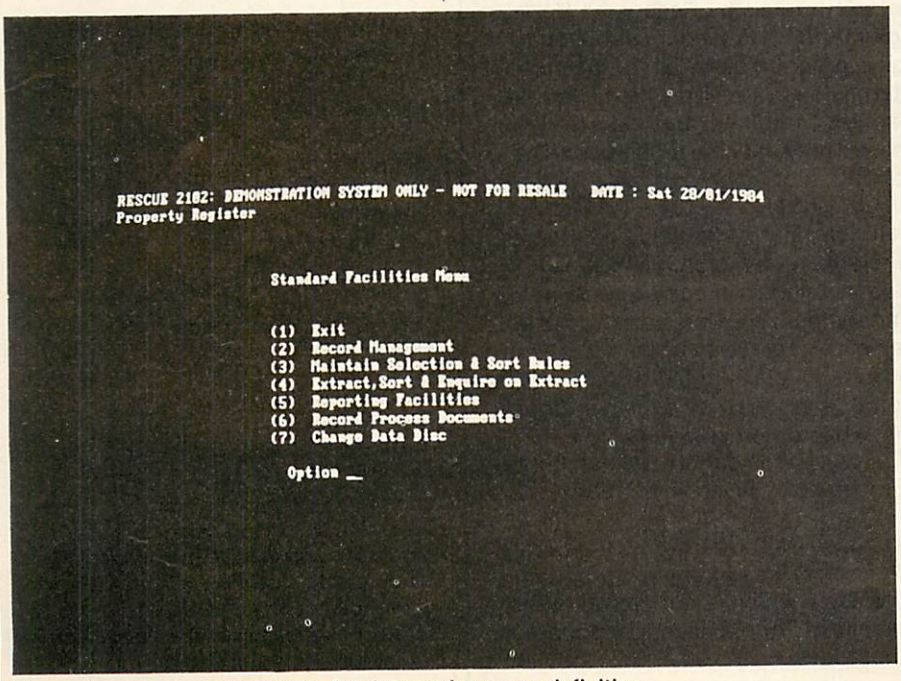


Figure 1. One of the two menu networks in Rescue.

of inefficient programming, maintenance and enhancement problems, and the need for disc-swapping dexterity as different functions are used.

Setting up the systems to run on the computer is easy. Tomorrow's Office has the most polished screen presentation — see the opposite page — while Delta's option menus and many messages make it the easiest to operate. Rescue has separate programs for data and process definition and for run-time features, and each has its own burgeoning network of menus — see figure 1. A neat help facility provides a short message when ? is entered in response to a prompt.

Rescue uses flat files of fixed-length records which hold up to 1,024 bytes. Each one can cope with up to 10 fields nominated as access keys. Tomorrow's Office and Delta use a master/transaction file structure with one master field nominated as the access key, which in Delta's case is sequenced. Tomorrow's Office allows only 508 bytes to be shared out between a master and transaction definition, while Delta permits up to 2,000 bytes. The maximum file size for Delta and Rescue is around 33,000 master records; Tomorrow's Office can handle multi-volume files to give 99 times this limit.


RESCUE 2102: DEMONSTRATION SYSTEM ONLY - NOT FOR RESALE DATE : Sat 28/01/1984
Property Register
Standard Facilities Menu
(1) Exit
(2) Record Management
(3) Maintain Selection & Sort Rules
(4) Extract,Sort & Enquire on Extract
(5) Reporting Facilities
(6) Record Process Documents
(7) Change Data Disc
Option _

Rescue has separate programs for data and process definition.

The process of defining a data file is prompt-driven. All the systems request entries for field name, type and length, which is a tedious business. It is made worse in Tomorrow's Office by a requirement for additional screen format data. Rescue is worse still, as it also requires report format data and prompts 13 or more times for each field. Field typing is from a standard set of character, number, or date, with an extended set for Rescue which makes provision for optimising disc storage space and for building in validation criteria.

Database systems are notoriously inept when it comes to changing the format of a file. Delta and Rescue allow a limited amount of restructuring without the need to create a new second copy of the data, and with Rescue new key fields can easily be nominated.

For major reorganisation the standard procedure is to copy fields from records in

(continued on next page)

A database by any other name

Delta

Delta is a package that is professionally produced and easy to use. It has a range of features designed to equal or better most of the competition. Its design shows an appealing degree of flexibility, and progressive enhancements should keep it alive for some years.

The master-file/transaction-file structure has much to recommend it. At the conceptual level it provides a first step towards the development of a real network of database files. Allowing eight transaction types is fine, but it is disappointing that only one can be accessed at a time; when using this type of structure it is natural to need to use more.

Another disappointment is the limited Process facility, which could at least be enhanced for use in validating input data. The Link and Copy facility is simple in concept, but it is good and flexible. It scores well for the data-entry logging option and for the ability to update records using an extract index.

Delta is well placed for a successful ride in the market-place. The fact that it is being distributed by IBM, DEC, and Xerox must be regarded as a recommendation.

Tomorrow's Office

This product rose to fame with the Sirius computer, and caters for many of the file-processing needs of its user. It uses a master/transaction file structure and has fairly attractive development screen displays which consistently prompt for entries on a command line at the bottom of a screen.

Its range of functions allows Tomorrow's Office to maintain its position in a feature-count with the competition. It is the only package among those reviewed that allows more than one volume of data, giving an almost unlimited file size. Multi-file allows secondary file look-ups and updates and is a feature worth having. It is not yet offered by Rescue or Delta.

Tomorrow's Office has grown so large that it is no longer usable on a small floppy-disc based system; changing program discs all the time soon becomes unbearably tedious. It is limited by a record size which cannot exceed 508 bytes for master and transaction combined, and more seriously by the fact that any master/transaction pair may only have one updating screen. No provision is made for the validation of input, and many features are not as complete as their equivalent in Delta.

Many data-processing systems contain information which is duplicated in different files, and it is here that the relatively new Multi-file option comes into play. When adding records to a main file, predetermined fields may be Filled from data held in a secondary file. Likewise, data from the main file may automatically be Put to a secondary file to update it. These two processes, Fill and Put, are in essence what Multi-file offers.

Multi-file uses windows in the creation of a process, as shown in figure 3. Some will contain processing options, while others may be scrolled across file-definition data. Most Multi-file processes can be defined simply by correctly positioning the cursor and pressing Enter to select both options and field names.

The limitations of Multi-file are largely those of Tomorrow's Office itself. It provides scope for handling data from several files at once, but only in the context of the 508-character main file. Data which is not stored in the main file or transferred to it cannot be accessed or displayed, and there is no real conditional processing at the field level.

(continued from previous page)

the old file to a newly defined and empty version. Here Tomorrow's Office leads the field with the Multi-file option. Delta's Link and Copy utility offers greater flexibility but requires more effort to use. Rescue has a Loader utility which will do the same for Rescue files.

The first chance to test whether or not a user view is independent of a data file layout comes during screen definition. I was recently involved in the design of a system to handle laboratory test results from customers' fuel samples. The prime piece of data is a fuel sample with transport/arrival information, laboratory test results and advice data that is sent back to the customer. That one record comes under three sets of fields, each with a different person responsible for updating them. What could be simpler than to provide three different screens to view the same record — one for the logging clerk, one for the lab manager and one for the fuel-quality adviser? Tomorrow's Office cannot deal with this problem. It provides only one screen view for updating a file. Delta and Rescue can have alternative updating screens and, unlike Tomorrow's Office, can spread data across more than one screen page.

Rescue provides a unique and useful feature which enables fields to be linked so that their display depends on values entered for previous fields. However, Delta is the outright winner for ease and sophistication in screen-design facilities — see figure 2. The Quick function enables immediate data entry on a screen which is generated automatically from the file description. A custom design is created by painting text on to the blank screen, and escaping to command mode to indicate data field names and display attributes.

Data validation

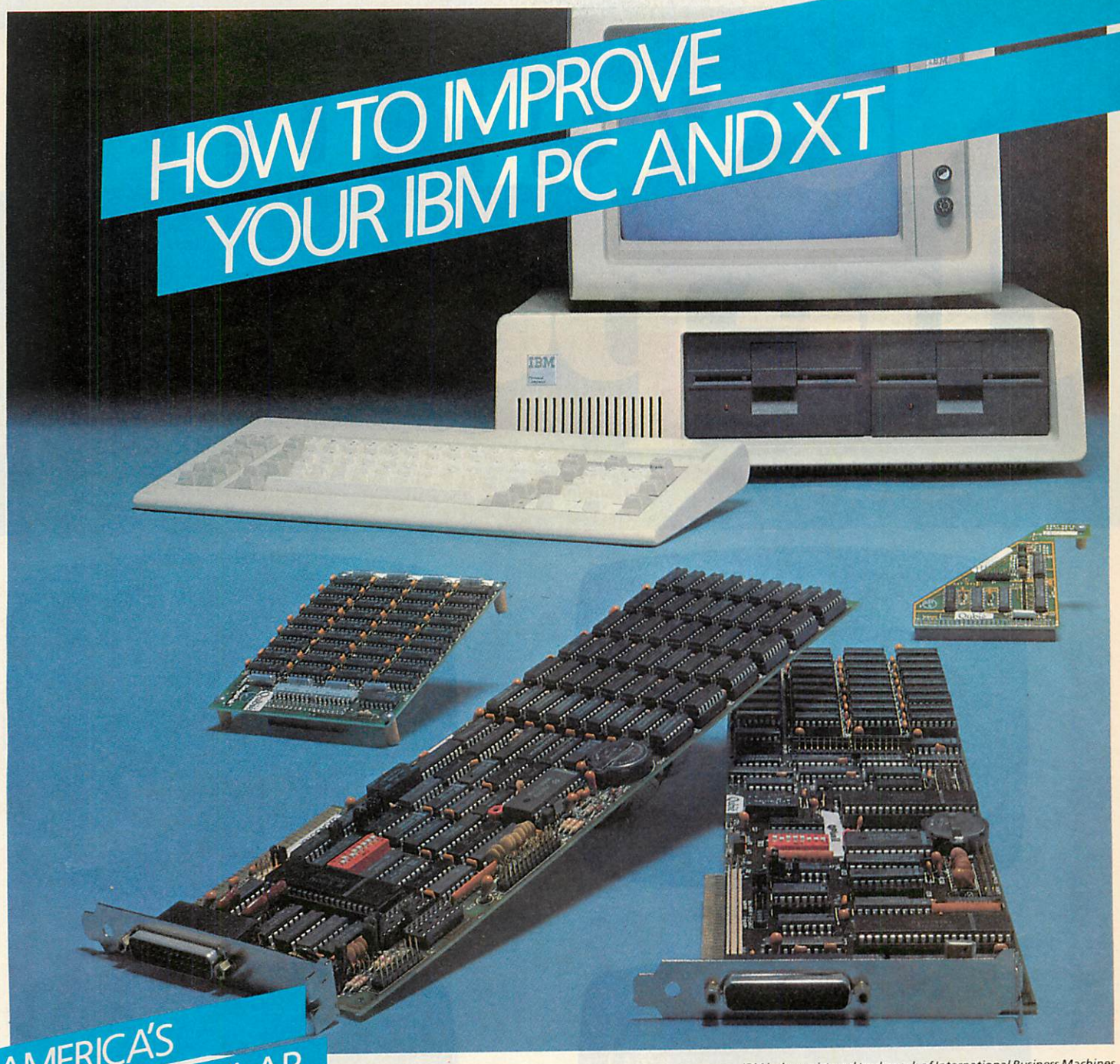
All three systems allow fields to be calculated from constants and entered field values. However, only Rescue addresses the serious requirement of data validation. For a first-time user it can be hard to grasp that a computer system based on inaccurate or out of date information is no better than a bad manual system.

Consider the simplest case of a field that should contain Y or N to indicate that an invoice is paid. What will happen to an invoice reporting system if the operator has entered H by mistake? Most systems have many fields where only certain values are acceptable. Rescue can associate a dictionary or table of correct values with a particular field which may be mandatory or optional. Numbers can be range checked and, furthermore, format masks may be used. These features are so valuable it is hard to understand why other designers have not followed Rescue's lead.

For data entry Delta provides a full-screen mode of operation, and alone has a useful logging option that will

(continued on page 57)

HOW TO IMPROVE YOUR IBM PC AND XT



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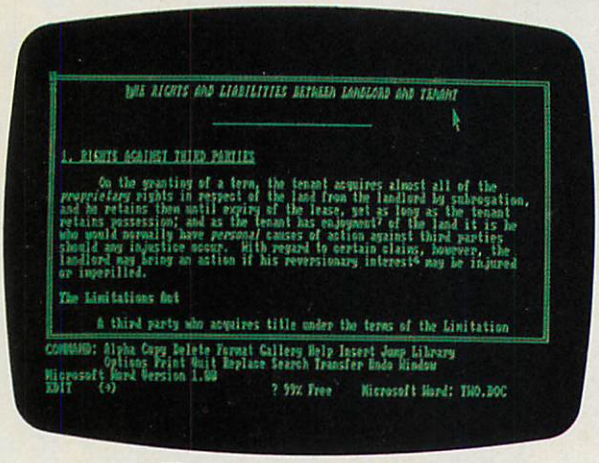
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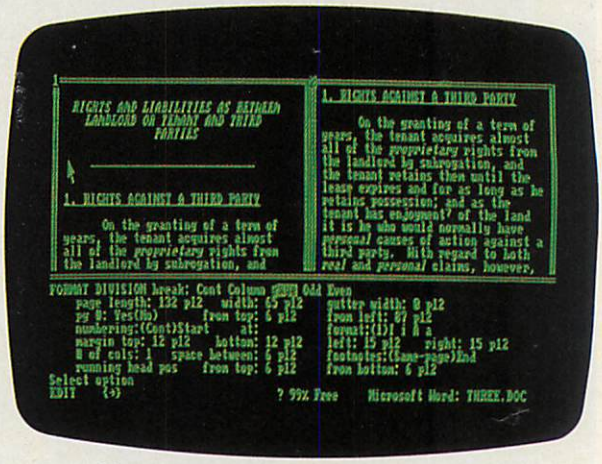
The Limitations Act
A third party who acquires title under the terms of the Limitation
COMMAND: Alpha Copy Delete Format Gallery Help Insert Jump Library
Options Print Quit Replace Search Transfer Undo Window
Microsoft Word Version 1.00
EDIT (+) ? 99% Free Microsoft Word: TWO.DOC

Format options.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page length: 132 pl2 width: 65 pl2 gutter width: 0 pl2
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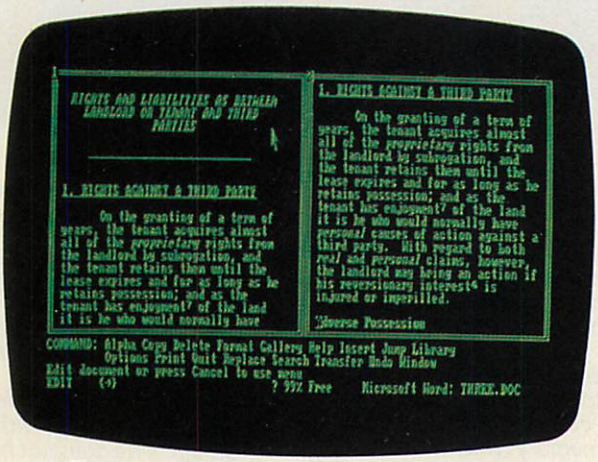
Layout and commands.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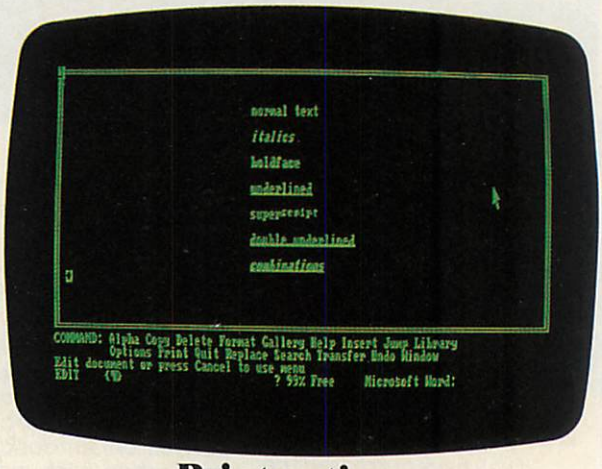
Reverse Possession
COMMAND: Alpha Copy Delete Format Gallery Help Insert Jump Library
Options Print Quit Replace Search Transfer Undo Window
Edit document or press Cancel to use menu
EDIT (+) ? 99% Free Microsoft Word: THREE.DOC

Formatting with windows.



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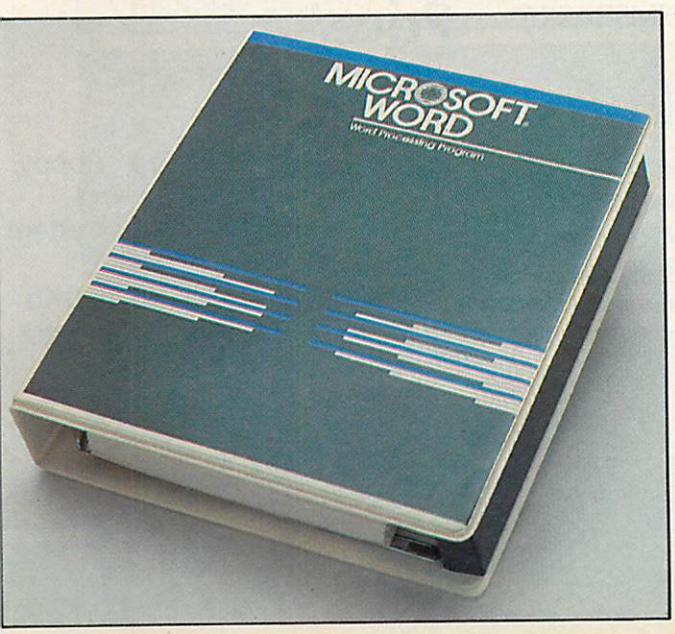

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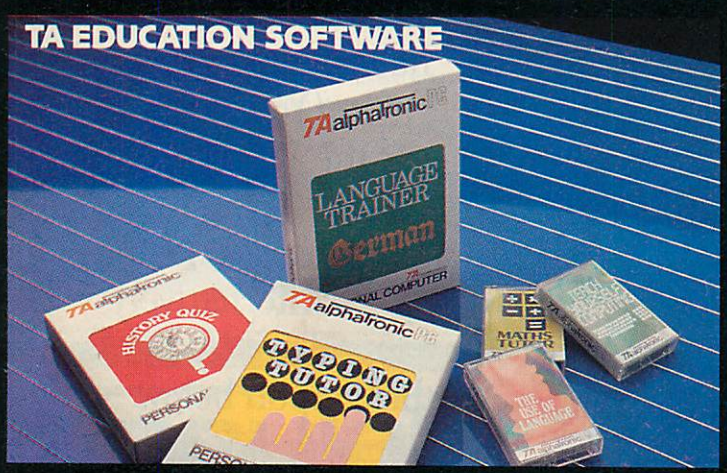
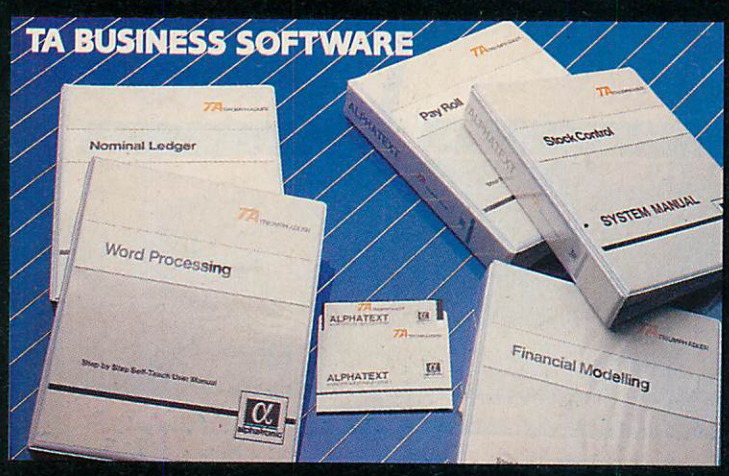
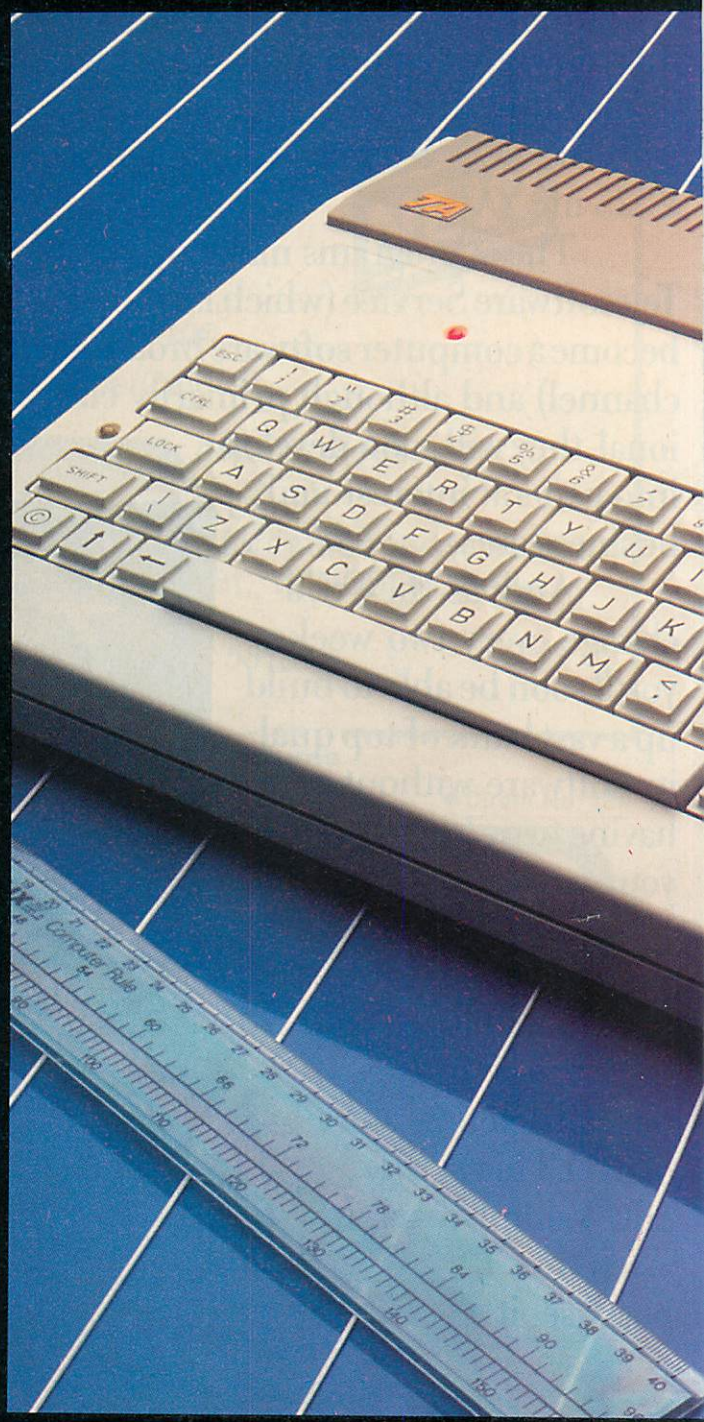
The Alphatronic







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The keyboard is a real delight compared with competitive models. There are very few confusing multi-function keys, and a really professional numeric keypad is included. Six separate keys can be programmed and indexed for special routines. And the full alphanumeric keyboard is just like a modern electronic typewriter.

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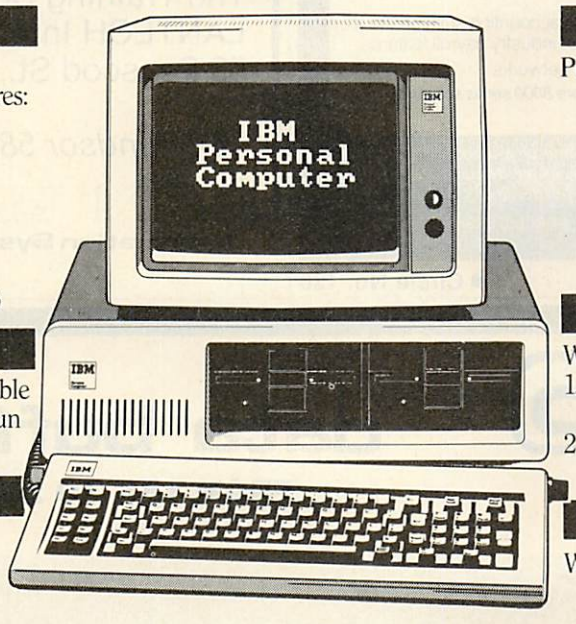

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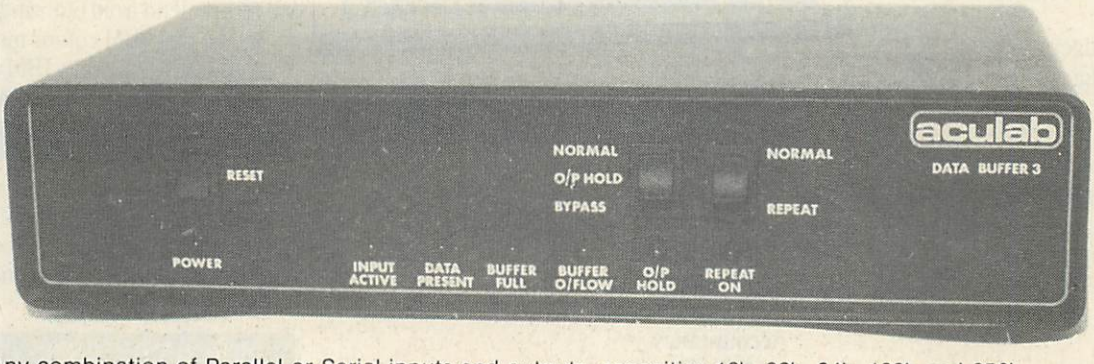

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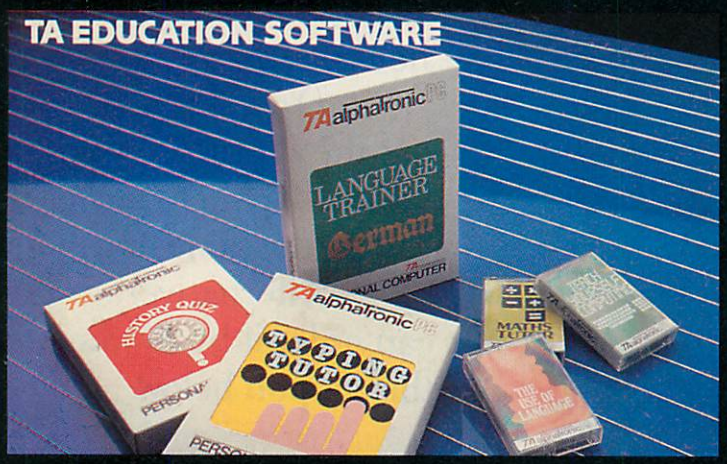

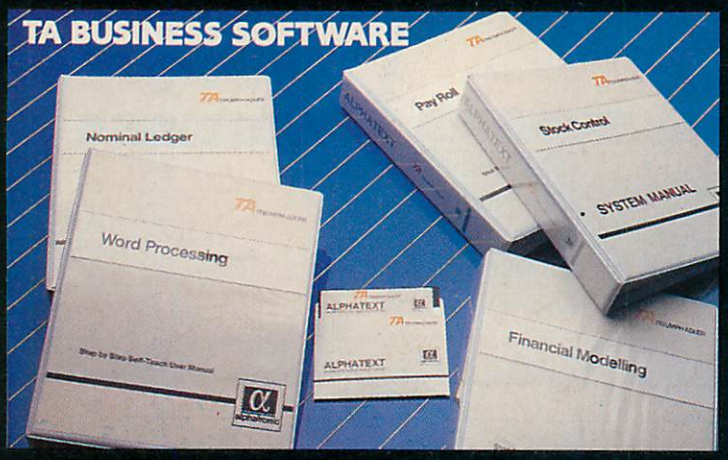

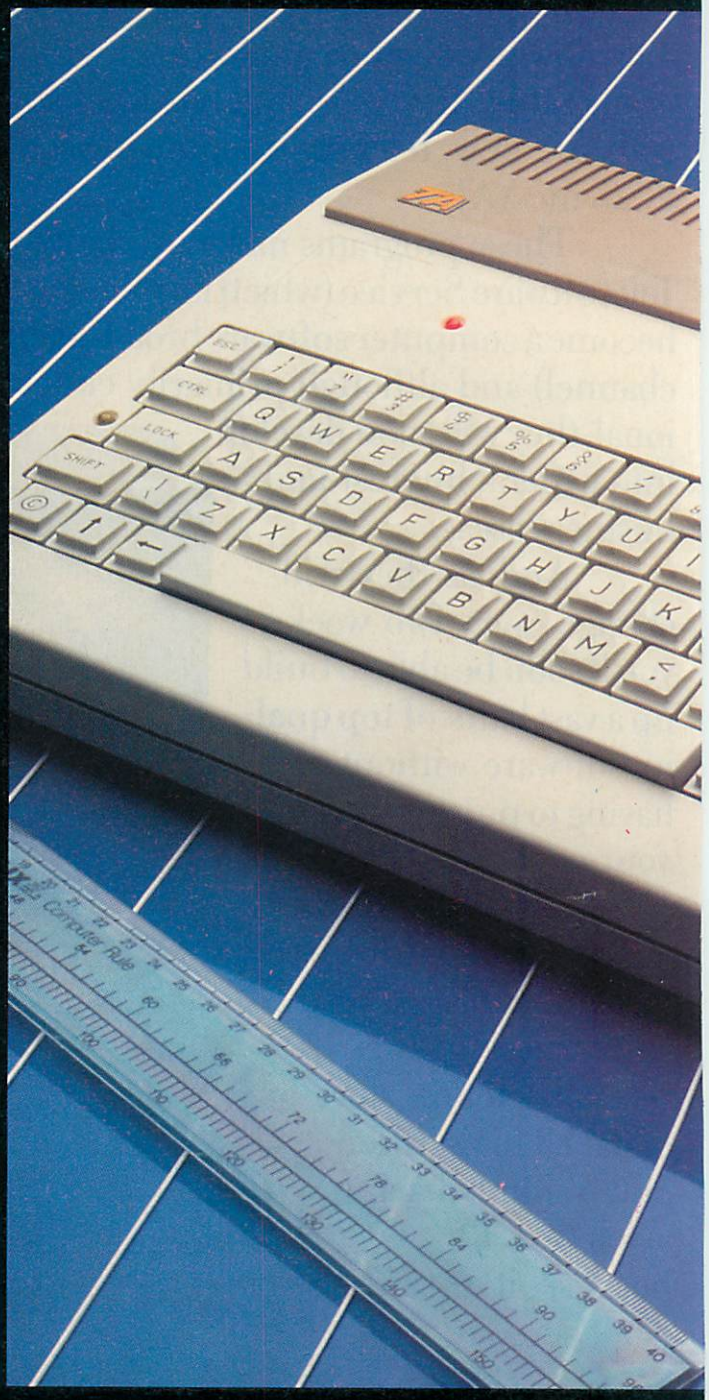

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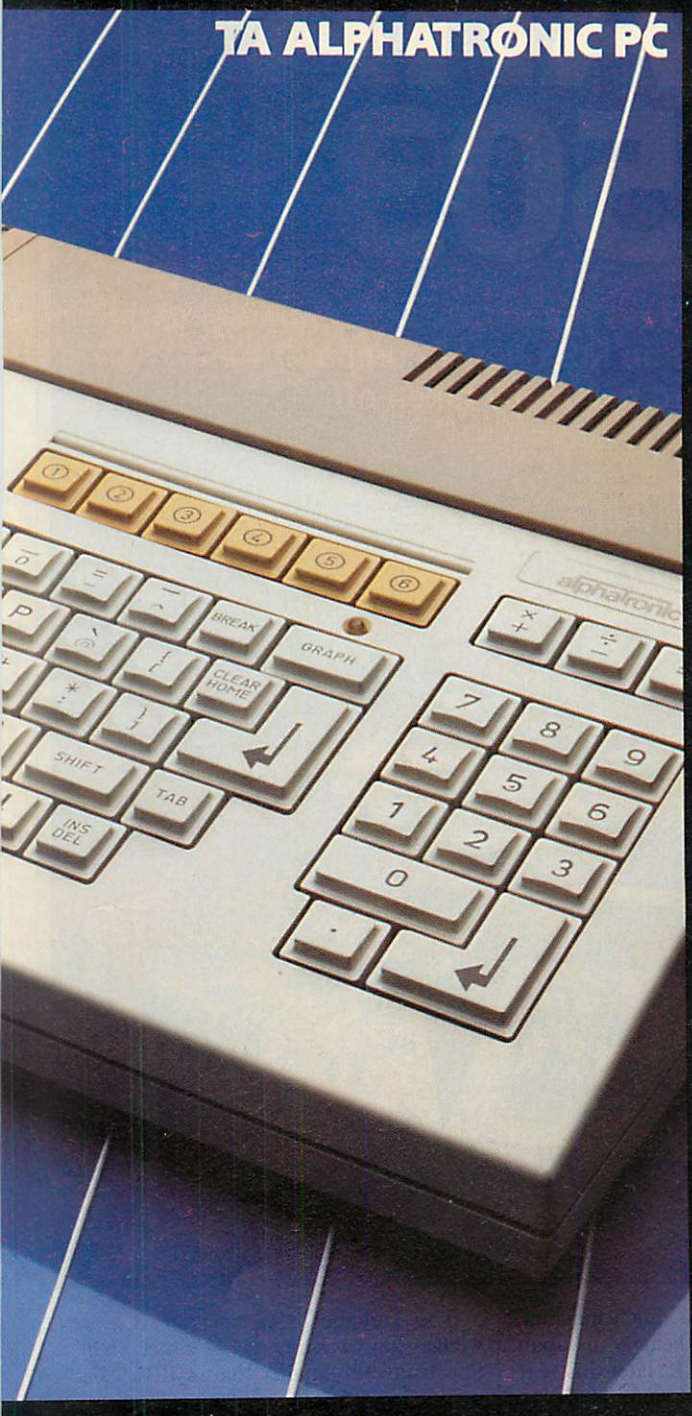
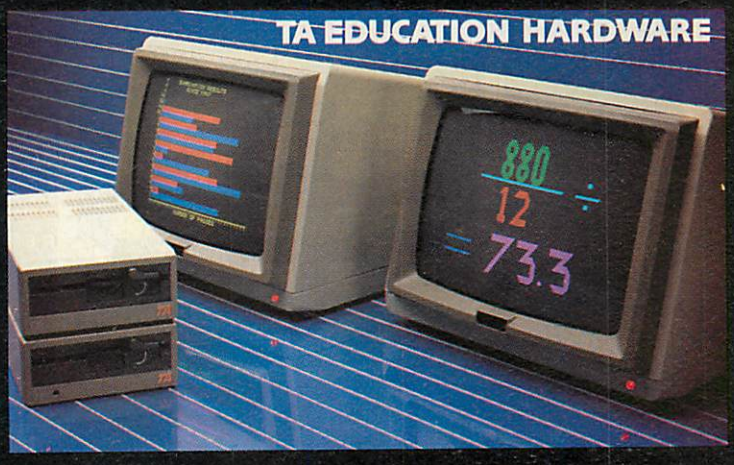
C means business





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YAMAHA YIS-503

MSX secures software portability across machines by standardising the hardware. Ian Stobie assesses an MSX home computer from Japan, where this standard has really taken off.

Demonstrating MSX compatibility, the Yamaha runs a program produced for Sony's Hit Bit machine.

PRACTICAL COMPUTING does not normally review machines that are not available in the U.K., but in some cases exceptions have to be made. The Yamaha YIS-503 is one of them. It is a Japanese MSX machine and thus typical of a large number of other MSX micros.

MSX is a hardware and software standard worked out between American software house Microsoft and 15 computer manufacturers, all but one of them Japanese. Essentially it is Microsoft Extended Basic, which gives the standard its name, plus a hardware specification which standardises I/O and graphics around a Z-80A based system with a 9918A display controller chip.

Cartridge, cassette and disc formats are defined in detail so that software from one MSX machine will run on other machines that observe the standard. Such machines are currently selling very heavily in Japan, and are expected in the U.K. later this year.

The Yamaha machine reviewed here was provided by Microsoft, which recently showed Japanese MSX models in the U.K., including machines from Sony, National Panasonic, Toshiba, and Fujitsu as well as Yamaha. Most interesting of the bunch are the Sony and the Yamaha offerings. The Sony Hit Bit seems to be the cheapest, while the Yamaha YIS-503 seems the best built and has an amazing, low-cost add-on synthesiser unit.

No U.K. marketing plans have been announced for any of these machines. There may be changes in styling and probably in name for Europe, but the prices in Japan suggest U.K. prices somewhere round the £200 mark.

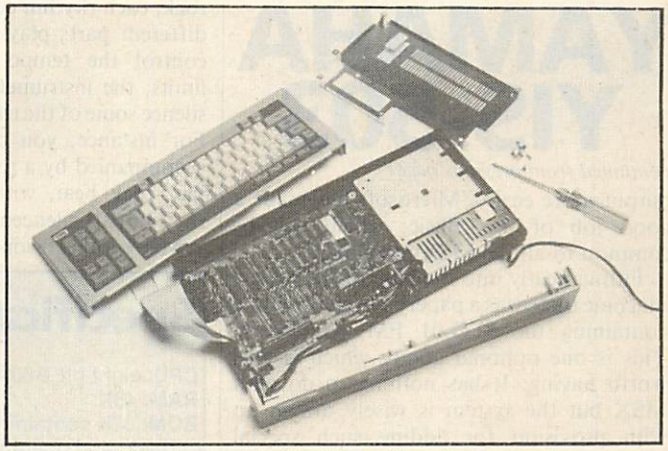
The Yamaha MSX machine is a grey, wedge-shaped unit. It is larger than a Spectrum but smaller than a BBC Micro, measuring 16.5in. by 8in. The full-size keyboard is well made and generates both upper- and lower-case characters. There are five function keys and the cursor-control keys are sensibly laid out.

The cartridge slot is located on the right, above the keyboard. There are two joystick ports on the side of the machine and printer, while cassette and general system interfaces are provided along the back. When plugged into the mains and connected to a TV, the system is ready to be turned on.

The system first presents a two-tone blue screen saying

> MSX system version 1.0
> copyright Microsoft Ltd

The optional synthesiser clips under the main unit.



Ample shielding is provided in this well engineered micro.

You are in Basic and ready to go. At this point we impulsively picked up an MSX game cartridge which comes with the Sony machine and pushed it into the cartridge slot. You are not meant to do this on most machines without first switching off, but the Yamaha seemed to survive. The screen flashed off and then came back on with a copyright message. We were successfully running a Japanese computer game developed for the Sony Hit Bit machine.

The Basic is a very full version based on GWBasic for the IBM. Some 28,815 bytes are free to the user on the Yamaha machine, which comes with a total of 48K, of which 16K is reserved for mapping the display. The MSX spec allows for machines with up to 1Mbyte of RAM organised in 16 blocks of 64K, and the Basic will support this without the user having to worry about bank switching.

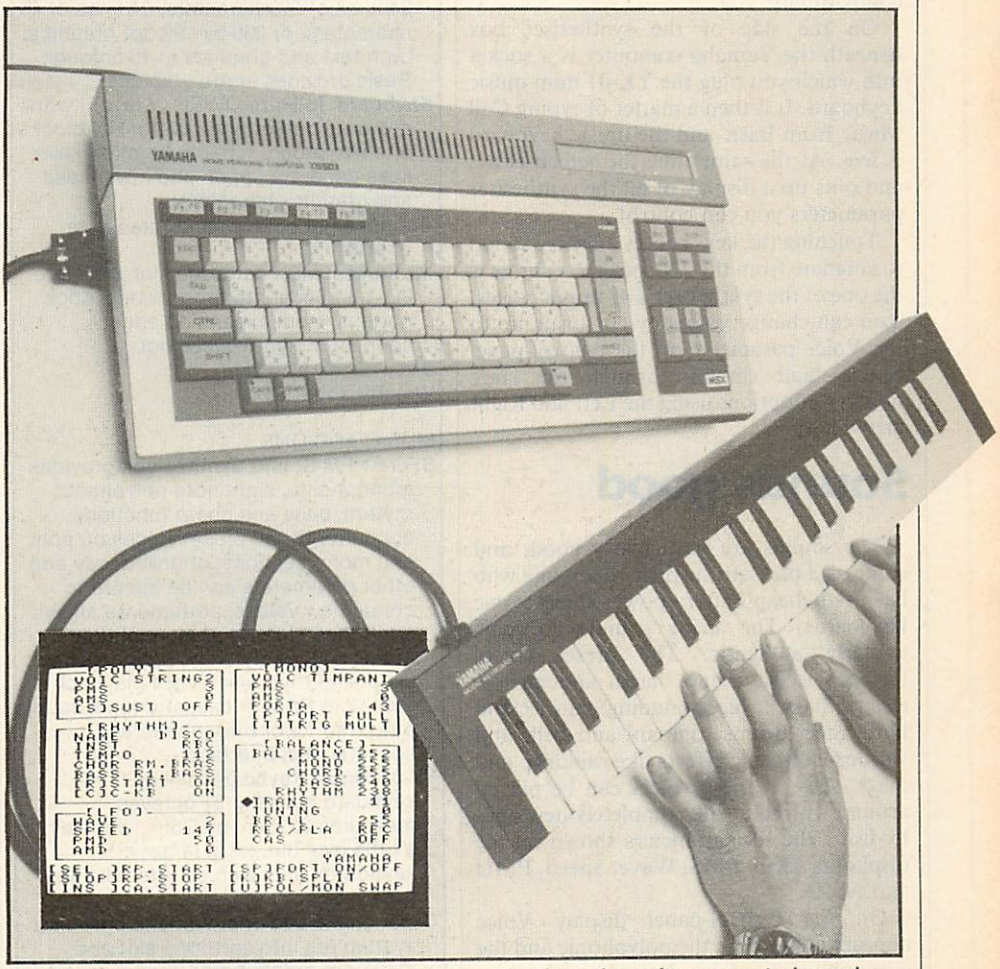
High precision

MSX Basic automatically calculates and displays numeric data to 14-significant-digit precision, which can sometimes make the system appear slow. It also supports a six-significant-digit variable type and integers, so obviously when programming you would declare the faster types whenever possible.

The 16-colour, 256-by-192 dot graphics are fully supported by Basic commands. They allow plotting, line, circle and box drawing, area filling, block copying and the drawing of shapes defined in string variables. Up to 32 sprites can be on the screen at a time, with the Basic providing simple ways of controlling them. Sound commands equal those of the Oric, and let you produce three-note chords over eight octaves with some control over the sound envelope.

Several intructions in the form On-Event-Gosub are provided, to eliminate the need for program-slowing loops just to wait for input. They redirect program flow when either a joystick button is pressed, a key hit or the in-built timer reaches a set value. The usual Microsoft string functions are provided, and there is a full, business-style Print Using command to format

(continued on next page)



The 3½-octave music keyboard plugs into the synthesiser; the software control panel is displayed on the screen by typing Call Music from Basic.

Benchmarks

The table shows the time in seconds to run eight standard Basic routines — see January issue, page 103 for listings. The Yamaha is rather faster than these particular figures suggest, as MSX Basic works out numeric variables with a 14-digit precision unless instructed otherwise. Benchmark 1, which repetitively executes an empty loop, takes 2.1s. with the default variable type but only 0.9s. using an integer variable. The Basic interpreter used was Microsoft MSX Basic version 1.0, as supplied with the Yamaha machine.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
BBC Model B—	1.0	3.1	8.3	8.7	9.2	13.9	52	14.8	
Yamaha YIS-503—Z-80A look-alike	2.1	6.0	16.6	18.4	19.0	31.7	44.9	216	44.3
Sinclair Spectrum—Z-80A	4.8	8.7	21.1	20.4	24.0	55.3	80.7	253	58.5

YAMAHA YIS-503

(continued from previous page)

output more easily. Microsoft has made a good job of this Basic, which will be common to all the MSX machines.

Fitting neatly into the base of the review machine there was a paperback-size module containing the SFG-01 FM synthesiser. This is one optional goody which is well worth having. It has nothing to do with MSX but the system is wisely drawn up with provision for adding such special features without compromising MSX compatibility.

On the side of the synthesiser box beneath the Yamaha computer is a socket into which you plug the YK-01 mini music keyboard. It is then a matter of typing Call Music from Basic and the music keyboard is live. At the same time the screen clears and puts up a display of all the synthesiser parameters you can control.

Touching the keys causes a brassy sound to emanate from the TV speaker — brass is the one of the synthesiser's 48 preset voices. You can change voices by cursoring up to the Voice parameter on the control-panel display and zipping through the large number of options using the Left and Right arrow keys.

Sounds good

The sounds are particularly good, and come as a pleasant surprise to anyone who has used cheap battery-powered electronic keyboards. The string sounds are particularly authentic. The preset voices include electric piano, harsh and mellow electric bass, a nice-sounding clarinet and horn, steel drums, timpani and bell, and various electronic effects like raindrop and tweet. Any of these voices can be played around with to create completely new ones by using the six parameters shown on the display as AMS, PMS, Wave, Speed, PMD and AMD.

On the control-panel display Voice appears under both the polyphonic and the monophonic headings. Polyphonic lets you play chords of up to eight notes at a time, while with monophonic you play just one note, but in compensation you can manipulate it in more ways.

The music keyboard can be split anywhere to create, in effect, two smaller keyboards. For example, you can play a polyphonic horn bass part with your left hand and a monophonic violin with your right hand. The parameter Porta, which appears on the screen control-panel, lets you slur notes played in the monophonic voice into each other in different ways. This allows you to bend guitar notes or play eccentric violin styles.

The automatic rhythm section offers six predefined rhythms, such as 16-beat or jazz rock, each rhythm consisting of up to four different parts playing together. You can control the tempo and choose, within limits, the instruments that play, or even silence some of the rhythm parts altogether. For instance, you can play horn chords accompanied by a rhythm guitar to a slow jazz rock beat, with the drum and high rhythm part silenced.

Many other wonderful things can be done with this unit, especially if it is placed in competent hands, but perhaps the main thing is that after using it for hours your ears don't hurt. The Yamaha will store what you play on the music keyboard into RAM for instant recall, or on to tape. The RAM limit seems to be several minutes long, but only your part is saved, not the automatic rhythm section.

The Midi interface on the side of the Yamaha synthesiser box is a major plus if you want to get seriously involved with electronic music. Midi is rapidly becoming established as the CP/M of the electronic keyboard world, with companies like Korg, Roland and Sequential Circuits adopting it. Midi compatibility lets you transfer stored program material between systems from different manufacturers, and allows one machine to sequence an array of other Midi synthesisers.

Yamaha's approach is to tie its computer offering into another technological leisure product area where it are strong, and in this it has been followed by some of the other Japanese MSX manufacturers. Sanyo has provided as MSX machine with the ability to merge computer-produced graphics on to video cassette material, and to grab frames of video and digitise them. JVC has a rack-mounted MSX system, to be used linked to its hi-fi systems. Part of the importance of MSX is the way it is being used to open up the home market.

Specification

CPU: eight-bit Z-80A look-alike
RAM: 48K
ROM: 32K containing Microsoft MSX Basic and operating system
Display: plugs into domestic TV; shows 24 lines of 32 characters, 24 lines of 40 characters, or 256-by-192 dot graphics; both text and graphics in 16 colours; Basic provides sprite graphics
Keyboard: full-size QWERTY layout with separate cursor and control-key blocks and five programmable function keys; keys generate upper- and lower-case and graphic characters
Sound: eight octaves and three-note chords
Interfaces: MSX cartridge slot, cassette I/O, parallel printer port, two joystick ports, system expansion edge connector, synthesiser slot
Size: 16.5in. by 8.25in.
Weight: about 5lb.

MUSIC ADD-ONS
SFG-01 FM Sound Synthesiser: provides monophonic, eight-note polyphonic, rhythm, bass and chord functions concurrently; 48 preset voices on poly and mono sections; attack, decay and other parameters can be altered to create new voices; portamento allows controlled slurring of monophonic notes; keyboard can be split any way; six preset rhythms; record playback facility to RAM or cassette tape; sound output to TV or through stereo sockets; Midi interface
YK-01 Music Keyboard: 44-key mini-keyboard covering 3½ octaves; measures 22.25in. by 5.5in., with keys a little over 3in. long; larger size keyboards may also be offered with the system
Other music add-ons: Yamaha play-card system fits into cartridge slot and plays pre-programmed tunes; music. ROM cartridges create new preset voices and provide music-composition aids for the SFG-01 synthesiser

AVAILABILITY
U.K. price: not decided, but possibly around £200 for the computer itself and about £550 for the complete computer plus musical keyboard plus synthesiser
U.K. distribution: not sorted out but probably here foir Christmas 1984; Yamaha's U.K. music keyboard business is conducted by Kemble Organ Sales Ltd, Mount Avenue, Bletchley, Milton Keynes, Buckinghamshire MK1 1JE. Telephone: (0908) 640202

Conclusions

● MSX cannot be ignored. Just because the machines have a Z-80 in them doesn't mean they are conservative.

● MSX Basic is very good, both for writing games and for more practical use.

● The MSX specification includes a definition of MSX-DOS, a disc operating system from Microsoft which will be file compatible with the MS-DOS used on 16-bit office machines. This holds out the possibility of some MSX machines emerging as very attractive home work-and-play machines along the lines of the Commodore 64. Microsoft is promising cut-down MSX versions of packages like Multiplan.

● Disc drives do not appear to be available yet for the MSX machines. Technically there would be little difficulty in attaching standard 5.25in. or Sony microfloppy drives, but the price would be out of step with the low cost of the MSX machines themselves. MSX may therefore spur Japanese manufacturers to develop cheap new mass-storage devices.

● To really take off in Europe and America MSX needs software, which has yet to be written.

● The Yamaha machine itself is a very competent computer for home use. It is well constructed, with few components, so it is probably cheap to manufacture.

● The Yamaha synthesiser add-on will prove irresistible to a great many people if the price is right.

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KAYPRO 10

Glyn Moody tests the big brother to the machine that was voted 1983's Transportable Computer of the Year.

AT FIRST SIGHT the Kaypro 10 looks like a large tin box. Take off the lid and it proves to be a large tin box with a 9in. screen, 64K of RAM, a 390K floppy and a 10Mbyte Winchester running CP/M on a Z-80. Unremarkable statistics perhaps, except that the complete system costs only £2,595 plus VAT.

Though the Kaypro is supposed to be transportable, little attempt has been made to cram components together. Disc units positively luxuriate in space and the main PCB straddles the CRT in a relaxed sort of way. The box is consequently a substantial size: 18in. wide by 15in. deep and 8in. high. Of course there is no reason why a fetish should be made of packed, inaccessible boards and units, but for a machine that aspires to portability a more frugal approach to the use of internal space would be more appropriate.

The CRT and its associated power unit lie beneath the main circuit board, as does the power supply. The circuitry for the discs is contained on a second board, positioned vertically alongside the floppy on the right of the machine. A noisy fan cools the disc and the power supply.

At the back of the machine, above the fan's external mounting, is the Reset button. Moving to the right of that you find a parallel port, an RS-232 port, modem port and two further jacks, one for the detachable keyboard, the other for a light-pen. Beneath them lies the brightness control; there seems to be no provision for contrast changes.

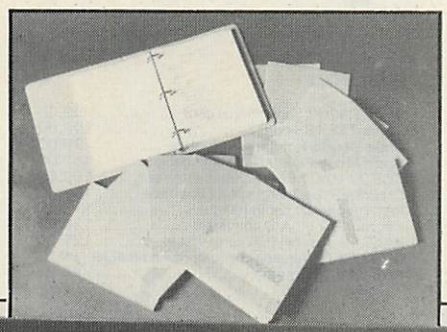
You heave the Kaypro around in the screen-down position, so a sturdy carrying strap is fitted on the back as well. The ports are left open to the elements, and the numerous ventilation slots render the internal circuitry vulnerable. The keyboard clips on to the front of the screen and acts as a base for the unit when it is being carried. Four plastic studs keep it off the ground.

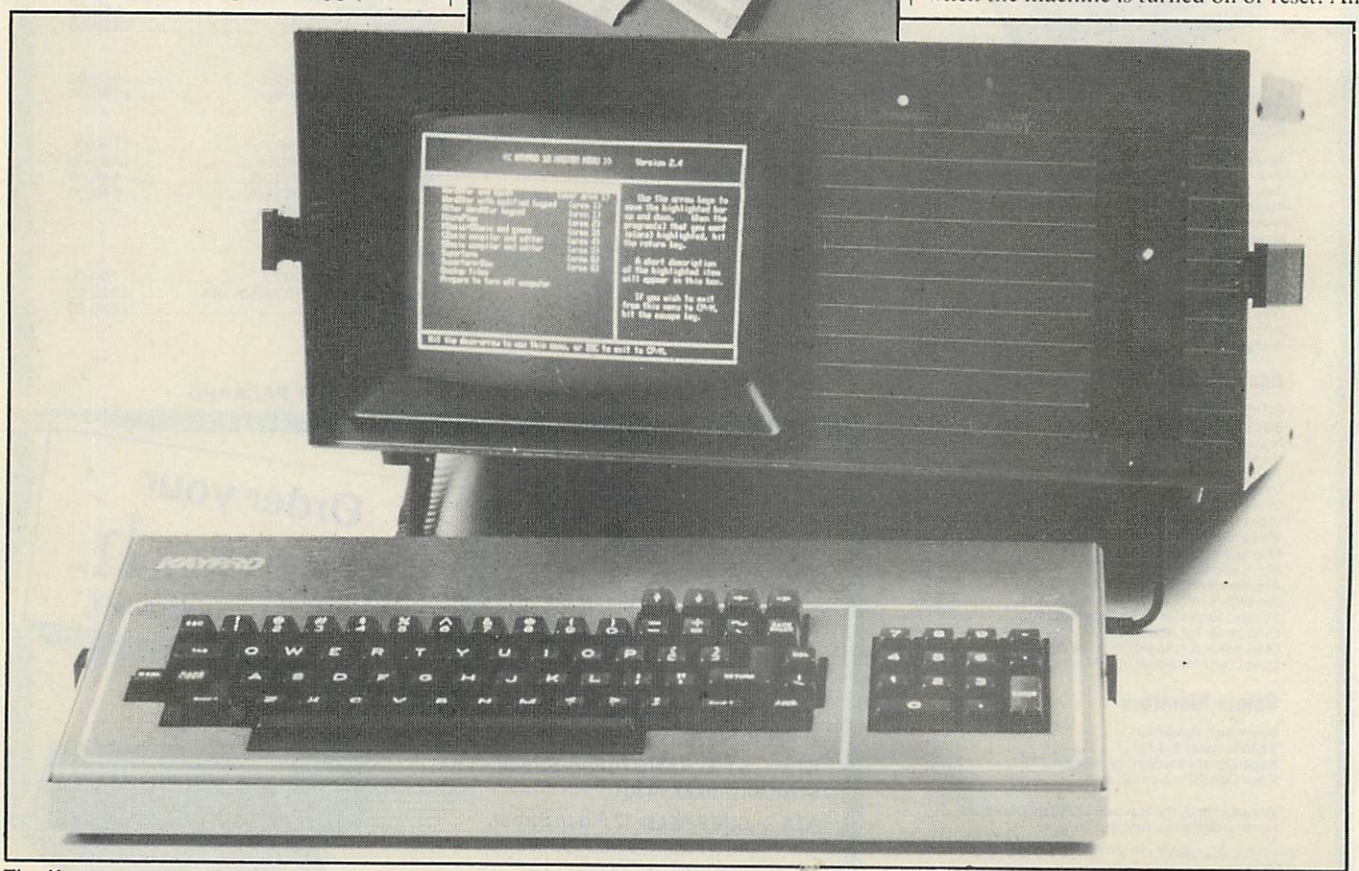
To set up the machine for use, you unclip the keyboard and unwrap the mains lead from four pegs on the back. A coiled cable links the keyboard to the appropriate jack, also at the back. While in use the machine can be angled on a built-in metal stand which pulls down from the front.

Keyboard fault

In addition to the standard QWERTY keys there is a numeric pad, but there are no function keys; four cursor keys lie along the top above the QWERTY number keys. The key movement is very shallow and over-sensitive, and the keys emit a tinny clanking sound when struck. For any touch-typist whose fingers have a tendency to linger on a key not in use the results are tiresome, with sprays of repeated characters peppering the text.

The 10Mbyte hard disc is partitioned into 16 users, numbered 0 to 15. User 0 contains all the CP/M system utilities, and it is from here that the boot sequence is initiated when the machine is turned on or reset. An





The Kaypro comes with a generous quantity of software installed on the 10MByte Winchester, including WordStar and three Basics.

autostart routine immediately calls up a master menu.

Kaypro has been generous with bundled software. User area 1 contains that old friend WordStar, along with a spelling checker from Oasis systems called The Word Plus. A subsidiary program allows the numeric keypad to be configured with a selection of the WordStar command strings. Micropro's standard WordStar reference manual is supplied with the package.

Spelling

The Word Plus has a dictionary of some 40,000 words, which is used to check text files in WordStar format. Words not in the main dictionary or appended special dictionaries are first identified and their contexts retained. Each unknown word is then reviewed on screen, and the user may correct it or add it to the dictionary.

Another facility available on The Word Plus is a program known as Find, which searches for words on the basis of crossword-type skeletons. For example

c?m?u?e?

will be found as "computer". The program also searches for words which begin and end with given strings, so

*hing

will produce all words in the dictionary that end in "hing".

The charmingly named Homonym Helper is intended for people who have difficulty in distinguishing between similar-sounding words, like compliment and complement, stationery and stationary, and even — if you are an American — bizarre and bazaar. The program searches through the text to locate potential trouble spots. In fact, as every *PC* reader is sure to know, these are homophones. Homonyms are words that have different meanings but are spelt the same, like "pole" as in North and "pole" as in telegraph. Such quibbles aside, these facilities should be a boon to crossword addicts.

User area 2 is the home of the spreadsheet application package. Kaypro has chosen Supercalc. Negotiations are currently under way for a suitable database package to complete the software trinity.

User areas 3, 4 and 5 all contain dialects of Basic. Along with Microsoft's interpreted MBasic, user area 3 includes a few ancient games written in that language's previous incarnation, called OBasic.

Digital Research's CBasic, accommodated in user area 4, is a compiled language. CBasic programs are written using a word-processing package in its non-text mode. The complete file is then compiled, though only to an intermediate program which must itself then be

(continued on next page)

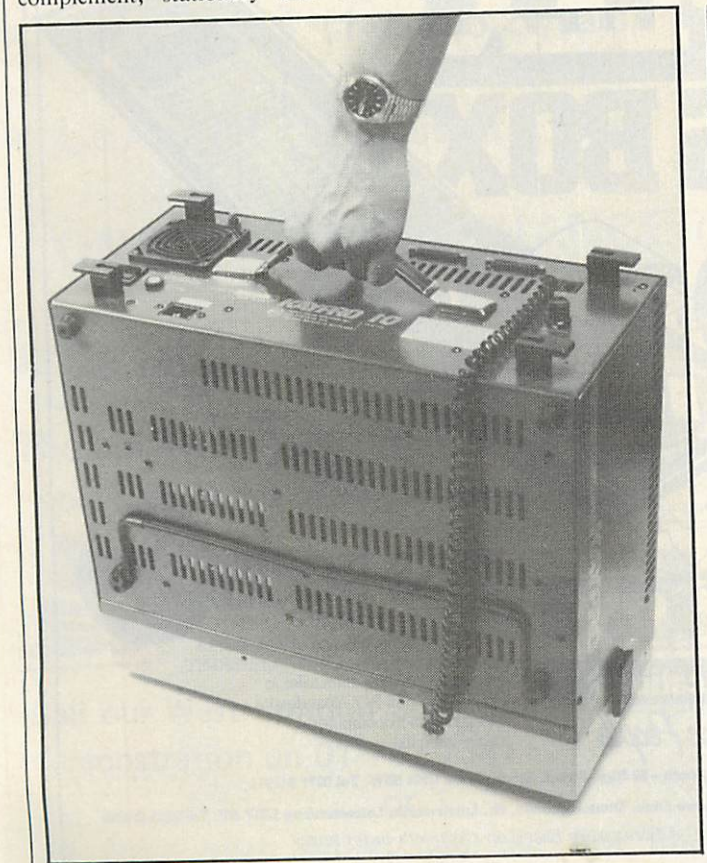
Specification

CPU: Z-80, eight-bit running at 4MHz
RAM: 64K
Dimensions: 18in. wide by 15in. deep by 8in. high
Weight: 31lb.
Display: 9in., 25-line by 80-character CRT
Keyboard: detached QWERTY with numeric keypad
Interfaces: parallel printer interface, RS-232C serial printer port, modem interface, keyboard and light-pen sockets
Discs: 5.25in. 380K floppy, 10Mbyte Winchester hard disc
Software in price: CP/M, MBasic, CBasic, SBasic, WordStar, Supercalc, The Word Plus, Suprterm
Hardware options: 5MHz card
Manufacturer: Non-Linear Systems of Solana Beach, California
U.K. distributor: CK Computers Ltd, Devonia House, High Street, Worle, Weston-super-Mare, Avon BS22 0JR. Telephone: (0934) 516246.
U.K. prices: Kaypro 10, £2,595; Kaypro II £1,520; Kaypro 4, £1,847; all prices exclude VAT

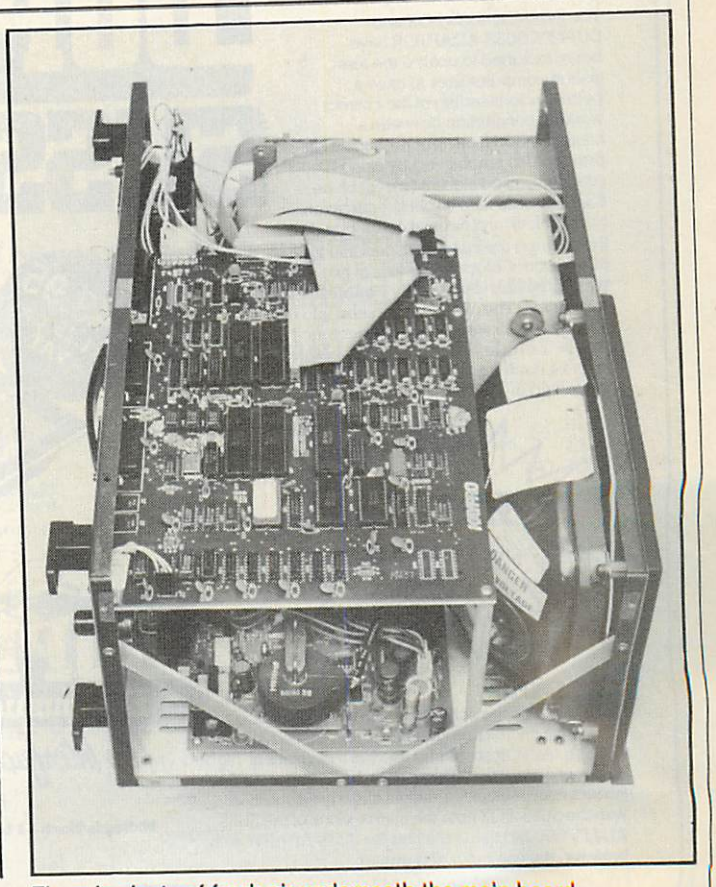
Benchmarks

Eight standard Benchmark routines — see *PC*, January issue, page 102 — were run in MBasic. The Kaypro emerges as a fast machine, neck and neck with the 8088-based IBM PC and close to the BBC Micro. All timings are in seconds.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Kaypro 10	1.2	3.8	9.5	9.7	10.5	19.0	29.5	51.0	16.9
BBC Model B—6502	1.0	3.1	8.3	8.7	9.2	13.9	21.9	52.0	14.8
IBM PC—8088	1.2	4.8	11.7	12.2	13.4	23.3	37.4	30.0	16.8
Sinclair Spectrum—Z-80	4.8	8.7	21.1	20.4	24.0	55.3	80.7	253.0	58.5



At 31lb. the machine is only just portable.



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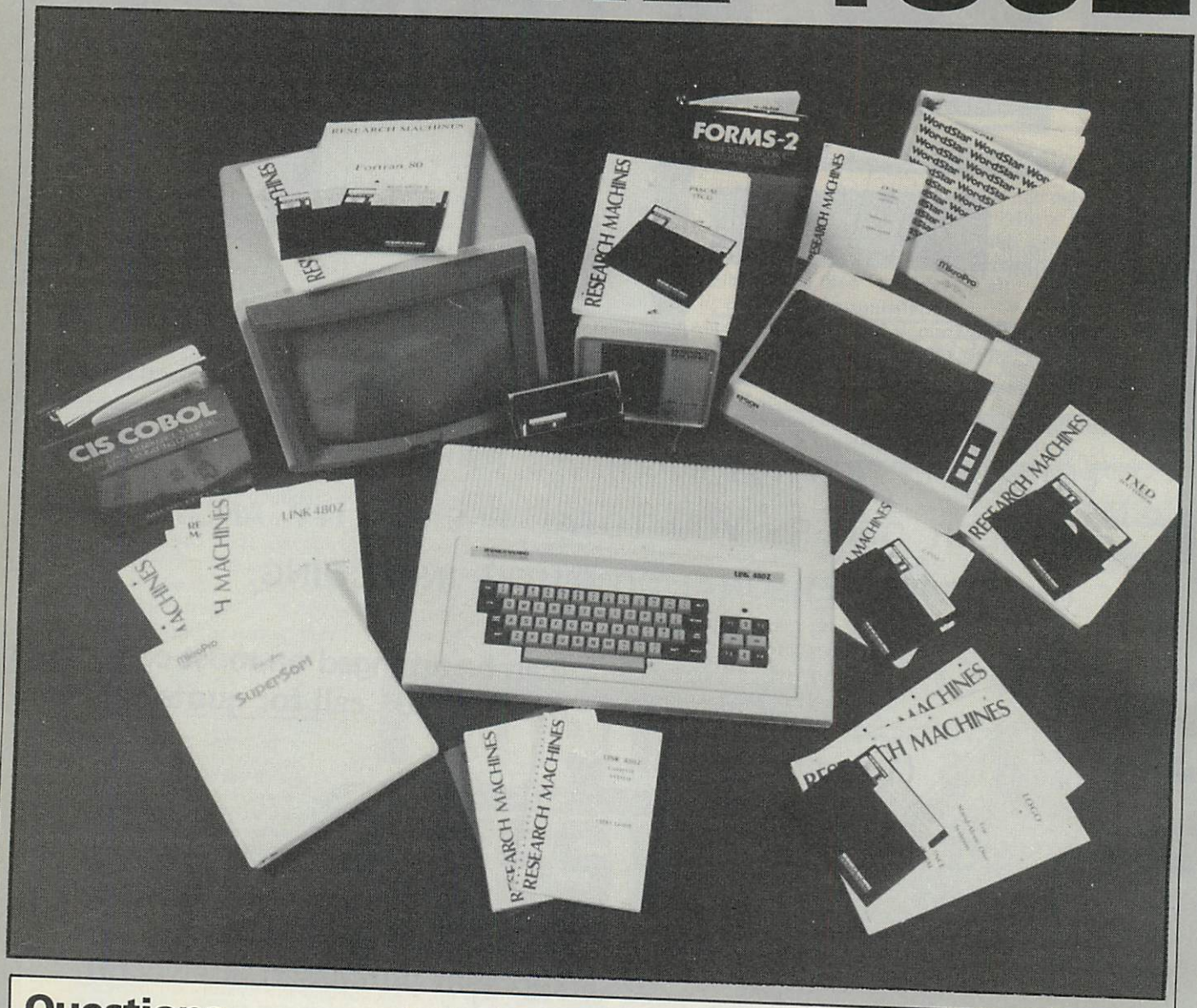

Questions

1. Which of these is **not** a programming language?
A. Dibol B. Snobol
C. Cobol D Lisp
E. Gargol

2. Which of these is not a **high-level** programming language?
A. Pascal B. Basic
C. Assembler D. Fortran
E. Cobol

3. When did high-level programming languages first come into use?
A. 1940s B. 1950s
C. 1960s D. 1970s
E. 1980s

4. Which of these languages was the most widely implemented?
A. Pascal B. Fortran
C. Basic D. Cobol
E. Logo

5. Which of these languages was first developed by Professors Kemeny and Kurtz?
A. Pascal B. Modula-2
C. BCPL D. Basic
E. Smalltalk

6. Which of these languages was originally developed to control radio-telescopes?
A. Logo B. Forth
C. Fortran D. Lisp
E. Occam

7. Which of these languages was designed for children to use, and embodied for the first time the idea of turtle graphics?
A. Logo B. Lisp
C. C D. Forth
E. Pilot

8. Which of these languages was designed with the intention of inculcating good structured programming habits among students?
A. Basic B. Fortran
C. Assembler D. C
E. Pascal

9. Which of these languages was developed in Britain?
A. Ada B. Pascal
C. BCPL D. Fortran
E. C

10. Which of the following figures is closest to the percentage of British secondary schools that use Research Machines 380Z or 480Z computers?
A. 5% B. 10%
C. 20% D. 40%
E. 80%

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KAYPRO 10

Glyn Moody tests the big brother to the machine that was voted 1983's Transportable Computer of the Year.

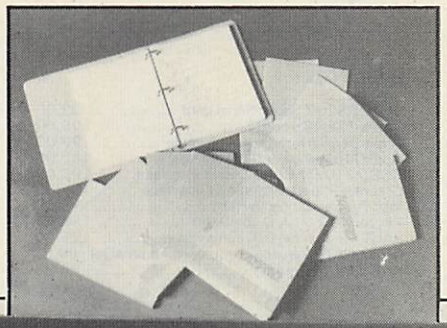
AT FIRST SIGHT the Kaypro 10 looks like a large tin box. Take off the lid and it proves to be a large tin box with a 9in. screen, 64K of RAM, a 390K floppy and a 10Mbyte Winchester running CP/M on a Z-80. Unremarkable statistics perhaps, except that the complete system costs only £2,595 plus VAT.

Though the Kaypro is supposed to be transportable, little attempt has been made to cram components together. Disc units positively luxuriate in space and the main PCB straddles the CRT in a relaxed sort of way. The box is consequently a substantial size: 18in. wide by 15in. deep and 8in. high. Of course there is no reason why a fetish should be made of packed, inaccessible boards and units, but for a machine that aspires to portability a more frugal approach to the use of internal space would be more appropriate.

The CRT and its associated power unit lie beneath the main circuit board, as does the power supply. The circuitry for the discs is contained on a second board, positioned vertically alongside the floppy on the right of the machine. A noisy fan cools the disc and the power supply.

At the back of the machine, above the fan's external mounting, is the Reset button. Moving to the right of that you find a parallel port, an RS-232 port, modem port and two further jacks, one for the detachable keyboard, the other for a light-pen. Beneath them lies the brightness control; there seems to be no provision for contrast changes.

You heave the Kaypro around in the screen-down position, so a sturdy carrying strap is fitted on the back as well. The ports are left open to the elements, and the numerous ventilation slots render the internal circuitry vulnerable. The keyboard clips on to the front of the screen and acts as a base for the unit when it is being carried. Four plastic studs keep it off the ground.

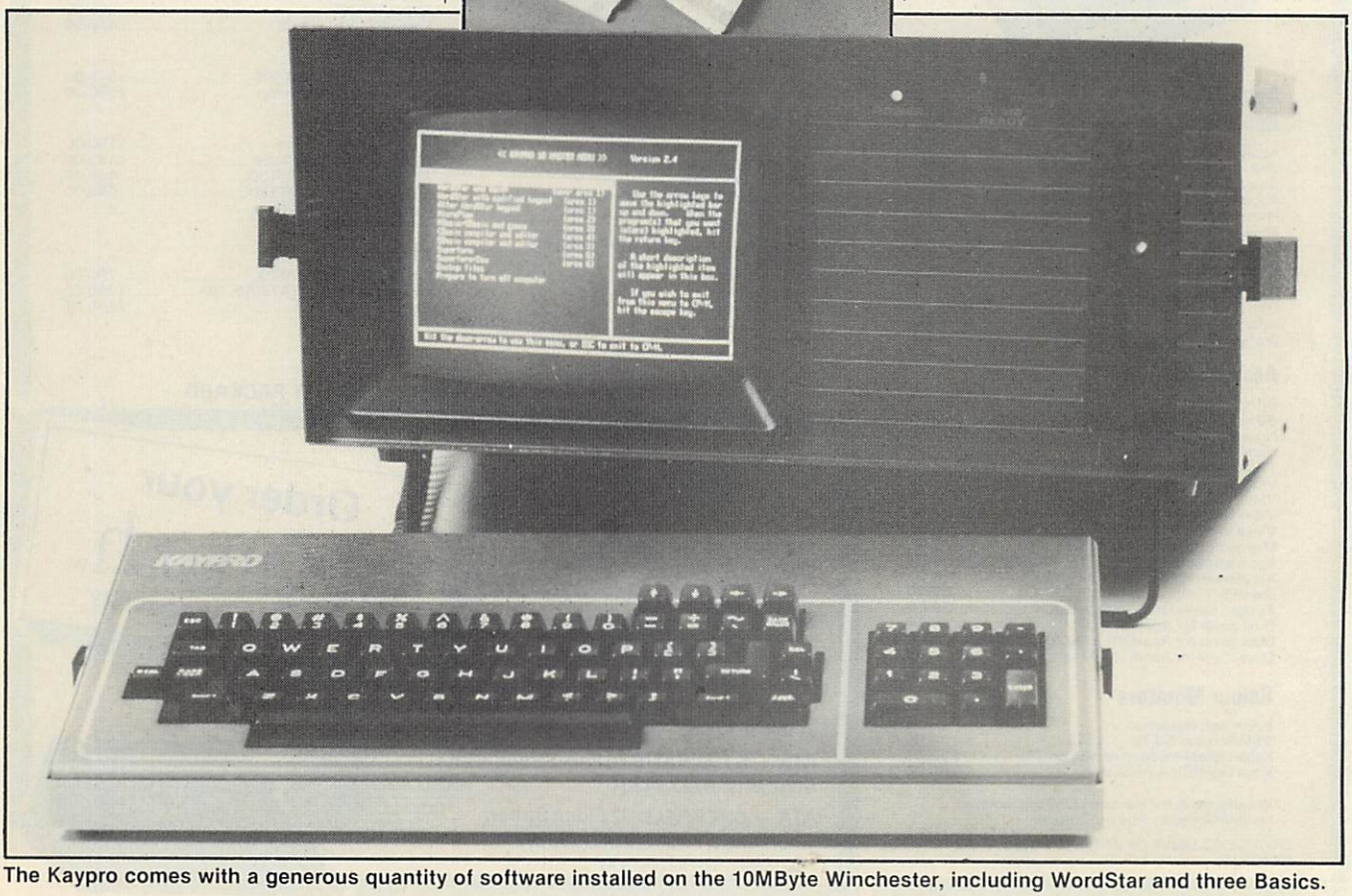


To set up the machine for use, you unclip the keyboard and unwrap the mains lead from four pegs on the back. A coiled cable links the keyboard to the appropriate jack, also at the back. While in use the machine can be angled on a built-in metal stand which pulls down from the front.

Keyboard fault

In addition to the standard QWERTY keys there is a numeric pad, but there are no function keys; four cursor keys lie along the top above the QWERTY number keys. The key movement is very shallow and over-sensitive, and the keys emit a tinny clanking sound when struck. For any touch-typist whose fingers have a tendency to linger on a key not in use the results are tiresome, with sprays of repeated characters peppering the text.

The 10Mbyte hard disc is partitioned into 16 users, numbered 0 to 15. User 0 contains all the CP/M system utilities, and it is from here that the boot sequence is initiated when the machine is turned on or reset. An



The Kaypro comes with a generous quantity of software installed on the 10MByte Winchester, including WordStar and three Basics.

autostart routine immediately calls up a master menu.

Kaypro has been generous with bundled software. User area 1 contains that old friend WordStar, along with a spelling checker from Oasis systems called The Word Plus. A subsidiary program allows the numeric keypad to be configured with a selection of the WordStar command strings. Micropro's standard WordStar reference manual is supplied with the package.

Spelling

The Word Plus has a dictionary of some 40,000 words, which is used to check text files in WordStar format. Words not in the main dictionary or appended special dictionaries are first identified and their contexts retained. Each unknown word is then reviewed on screen, and the user may correct it or add it to the dictionary.

Another facility available on The Word Plus is a program known as Find, which searches for words on the basis of crossword-type skeletons. For example

c?m?u?e?

will be found as "computer". The program also searches for words which begin and end with given strings, so

*hing

will produce all words in the dictionary that end in "hing".

The charmingly named Homonym Helper is intended for people who have difficulty in distinguishing between similar-sounding words, like compliment and complement, stationery and stationary, and even — if you are an American — bizarre and bazaar. The program searches through the text to locate potential trouble spots. In fact, as every *PC* reader is sure to know, these are homophones. Homonyms are words that have different meanings but are spelt the same, like "pole" as in North and "pole" as in telegraph. Such quibbles aside, these facilities should be a boon to crossword addicts.

User area 2 is the home of the spreadsheet application package. Kaypro has chosen Supercalc. Negotiations are currently under way for a suitable database package to complete the software trinity.

User areas 3, 4 and 5 all contain dialects of Basic. Along with Microsoft's interpreted MBasic, user area 3 includes a few ancient games written in that language's previous incarnation, called OBasic.

Digital Research's CBasic, accommodated in user area 4, is a compiled language. CBasic programs are written using a word-processing package in its non-text mode. The complete file is then compiled, though only to an intermediate program which must itself then be

(continued on next page)

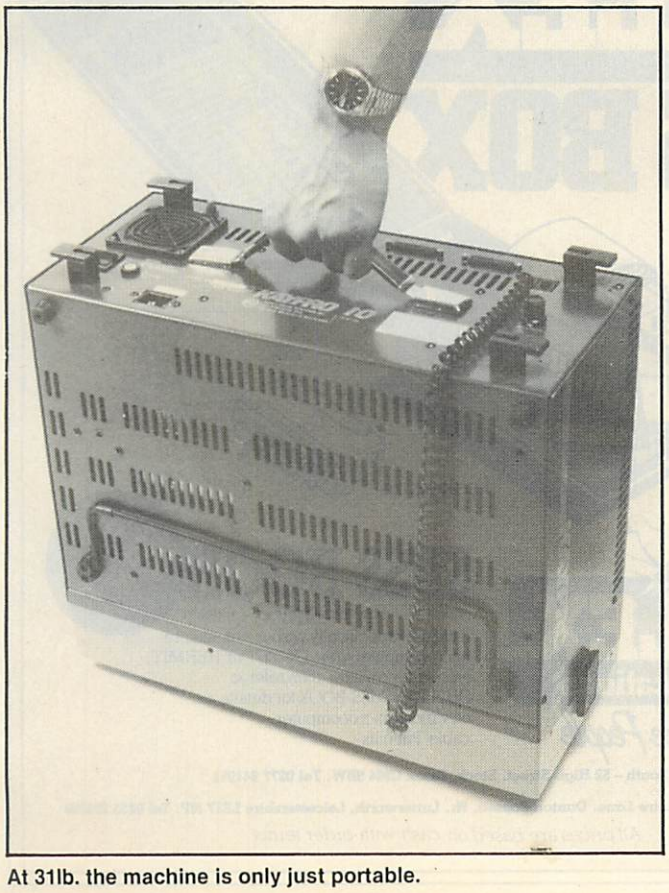
Specification

CPU: Z-80, eight-bit running at 4MHz
RAM: 64K
Dimensions: 18in. wide by 15in. deep by 8in. high
Weight: 31lb.
Display: 9in., 25-line by 80-character CRT
Keyboard: detached QWERTY with numeric keypad
Interfaces: parallel printer interface, RS-232C serial printer port, modem interface, keyboard and light-pen sockets
Discs: 5.25in. 380K floppy, 10Mbyte Winchester hard disc
Software in price: CP/M, MBasic, CBasic, SBasic, WordStar, Supercalc, The Word Plus, Suprterm
Hardware options: 5MHz card
Manufacturer: Non-Linear Systems of Solana Beach, California
U.K. distributor: CK Computers Ltd, Devonia House, High Street, Worle, Weston-super-Mare, Avon BS22 0JR. Telephone: (0934) 516246.
U.K. prices: Kaypro 10, £2,595; Kaypro II £1,520; Kaypro 4, £1,847; all prices exclude VAT

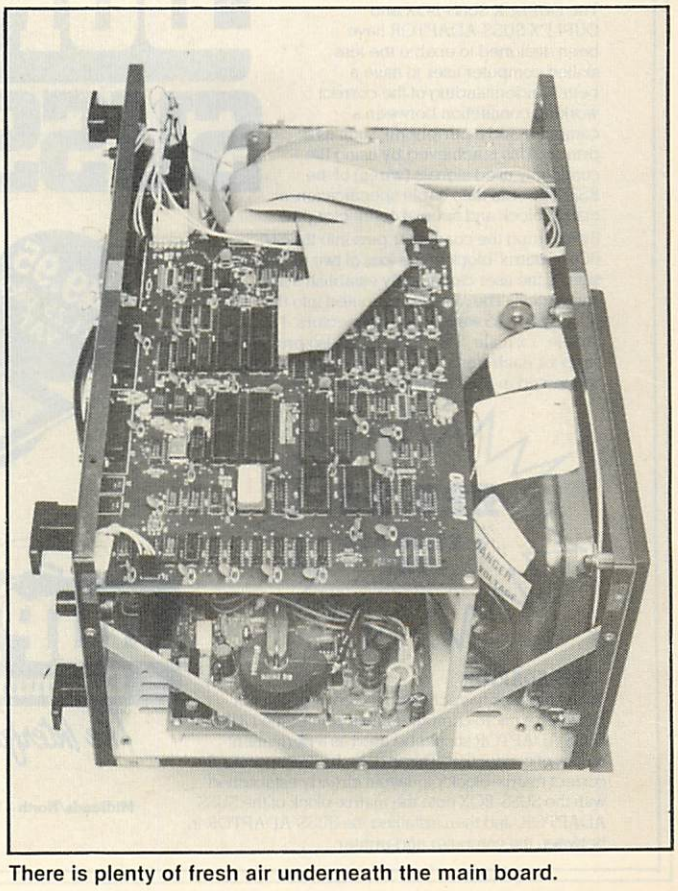
Benchmarks

Eight standard Benchmark routines — see *PC*, January issue, page 102 — were run in MBasic. The Kaypro emerges as a fast machine, neck and neck with the 8088-based IBM PC and close to the BBC Micro. All timings are in seconds.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Kaypro 10	1.2	3.8	9.5	9.7	10.5	19.0	29.5	51.0	16.9
BBC Model B—6502	1.0	3.1	8.3	8.7	9.2	13.9	21.9	52.0	14.8
IBM PC—8088	1.2	4.8	11.7	12.2	13.4	23.3	37.4	30.0	16.8
Sinclair Spectrum—Z-80	4.8	8.7	21.1	20.4	24.0	55.3	80.7	253.0	58.5



At 31lb. the machine is only just portable.



There is plenty of fresh air underneath the main board.

(continued from previous page)
interpreted. Though it takes more effort to produce, the resulting program runs much faster than one in ordinary interpreted Basic.

SBasic, the dialect provided in user area 5, is also compiled, and structured too. This means that it includes such programming luxuries as procedures and functions, If-Then-Else syntax, While, Repeat and Case. No line numbers are necessary, and Goto calls are addressed by additional labels. Recursion is allowed in both procedure and function calls. The price to be paid for all these goodies is that variable types must be declared at the start of the program. Who will want all these features and two other Basics is not clear, but it is nice to have them.

Full provision

The final sector of the partitioned Winchester offers the impressively named Suprterm. It allows the Kaypro to be hooked up to on-line information sources via an RS-232 port, with or without a modem. The command structures are not particularly clear, though doubtless anyone wanting to use this facility frequently will soon get the hang of them. The program is probably more significant because of its presence in the bundled software than for the facilities it offers.

Also available on the master menu is the system shut-down option. This places the head of the hard disc in the safety zone, well away from data-bearing sectors. The unit may then be switched off at the rear and transported.

All the application packages and languages come with supporting documentation, most of it proprietary to the software house. In addition to these specific guides, Kaypro sensibly provides a summary of the software supplied and a general manual.

The manual is commendably full and unfussy. As well as background information on the hardware and its configuration, there is yet another tour of the software. One problem is that the software bundled with the Kaypro 10 seems to be changing slightly as time goes by. The manual does not keep up with it; but this will presumably be no problem when things have settled down. A glossary and index complete the contents.

The Kaypro runs the Z-80 at 4MHz, but a 5MHz card is available. Other add-ons in the offing are an 8088 board which takes the RAM to 256K and allows IBM-format discs to be read. Battery packs and real-time clocks are planned for the future.

The Kaypro series represents the first computers from Non-Linear Systems of Solana Beach, California. The name of the machine derives from that of the controlling Kay family. Hitherto the main product lines have been research test equipment, the company having brought out one of the first digital voltmeters. With nominal portability and a certain ruggedness of construction, the Kaypro machines are continuing in this vein. Last year 53,000 units were shipped, and sales reached $75 million. In addition to the top of the range Kaypro 10, two floppy-based versions are available: the Kaypro II and 4, with single- and double-sided double-density discs respectively.

Conclusions

- **It may be inelegant and noisy, but if you are looking for a 10Mbyte CP/M system the Kaypro is probably a bargain.**
- **There is a generous amount of bundled software, all accompanied by documentation.**
- **Billed as portable, the machine is in fact just about luggable. It is large and ungainly: more could be done to reduce its bulk, and probably its weight too.**
- **The keyboard lets down what would otherwise be an eminently usable system. Until something is done about its tactile response, the Kaypro cannot really be recommended for use as a word-processing machine.**
- **The Kaypro seems ideally suited for basic, all-round business use where convenience rather than elegance is paramount, and where price counts for more than advanced specification.**

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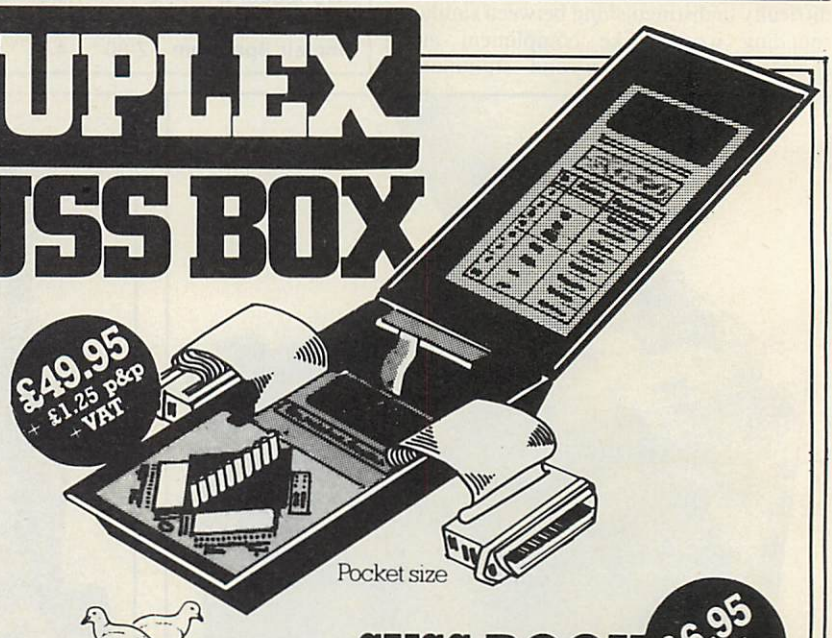

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RML 480Z

Questions

1. Which of these is **not** a programming language?
A. Dibol B. Snobol
C. Cobol D Lisp
E. Gargol

2. Which of these is not a **high-level** programming language?
A. Pascal B. Basic
C. Assembler D. Fortran
E. Cobol

3. When did high-level programming languages first come into use?
A. 1940s B. 1950s
C. 1960s D. 1970s
E. 1980s

4. Which of these languages was the first to be implemented?
A. Pascal B. Fortran
C. Basic D. Cobol
E. Logo

5. Which of these languages was first developed by Professors Kemeny and Kurtz?
A. Pascal B. Modula-2
C. BCPL D. Basic
E. Smalltalk

6. Which of these languages was originally developed to control radio-telescopes?
A. Logo B. Forth
C. Fortran D. Lisp
E. Occam

7. Which of these languages was designed for children to use, and embodied for the first time the idea of turtle graphics?
A. Logo B. Lisp
C. C D. Forth
E. Pilot

8. Which of these languages was designed with the intention of inculcating good structured programming habits among students?
A. Basic B. Fortran
C. Assembler D. C
E. Pascal

9. Which of these languages was developed in Britain?
A. Ada B. Pascal
C. BCPL D. Fortran
E. C

10. Which of the following figures is closest to the percentage of British secondary schools that use Research Machines 380Z or 480Z computers?
A. 5% B. 10%
C. 20% D. 40%
E. 80%

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The winning entry will be the one which in the judge's opinion answers the questions correctly and provides the most original and witty suggestions to the tie-breaker problems. Each question only has one correct answer. Write down the letter corresponding to the correct answer to each question in the boxes on the entry form. Then do the tie-breakers.

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The software bundle includes WordStar and Multiplan plus the Logo, Basic, Pascal, Cobol and Fortran languages. There are also Word, to teach word processing, Touch 'N' Go for keyboard skills, Sir for bibliographic retrieval techniques, and the Quest database.

Rules

1. The competition is open to all readers of *Practical Computing* normally resident in the U.K., except for employees of Business Press International Ltd or Research Machines Ltd, or their families.
2. Each entry must be written in ink on the official entry form printed here or on a clear photocopy. Only one entry per person is permitted.
3. Completed entry forms should be posted to the address shown on the entry form to arrive not later than April 30, 1984. Envelopes must be clearly marked "COMPETITION" in the top left corner.
4. The Editor of *Practical Computing* is the sole judge of the competition. No correspondence can be entered into regarding the result of the competition and it is a condition of entry that the judge's decision is final.
5. The winner will be notified by post and the result of the competition announced in the first available issue of *Practical Computing*. The winning entry will be reproduced, and other entries may be reproduced without payment.
6. The prize is a RML 480Z system with monitor, discs, printer and software. No cash substitute will be offered.
7. The prize will be awarded to the individual named on the winning entry form, unless the contestant names a U.K. educational institution they would like the prize to go to instead, in which case the prize will go to the institution.

Entry form for *Practical Computing* 480Z Languages Competition

Name .....

Address .....

.....

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If I win I want my prize awarded to .....

.....

.....

(write either "myself" or the name of a U.K. educational institution)

Signed .....

Answers

1. ☐	2. ☐	3. ☐	4. ☐	5. ☐
6. ☐	7. ☐	8. ☐	9. ☐	10. ☐

Tie-breakers

1. The name "Basic" is supposed to stand for Beginners' All-purpose Symbolic Instruction Code. Make up a name for a new language out of the initials of words explaining the special purpose of the language. The acronym does not have to be exact, but in any case limit yourself to under 12 words of explanation.

.....

.....

.....

2. *Practical Computing* is thinking of producing a tasteful sweatshirt; all we need is a suitable slogan. Suggest one of eight words or less.

First try .....

.....

.....

Second try .....

.....

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Return this entry form to: Practical Computing/ RML Competition, Room L306, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.
Write "COMPETITION" clearly on the top left-hand corner of the envelope. *

Health and efficiency

So you feel a bit off-colour and you think your micro might be able to tell you what's wrong. Chris Naylor has been looking at some medical programs.

EARLY LAST YEAR an article appeared in *The Times*: "Are you tired of not being able to see your GP when you want to?" it said. "Are you irritated by waiting room queues and the apology of an appointment system? If the answer to these questions is 'yes' then there is a breakthrough in 'home' medicine just available."

The breakthrough was, in fact, the first of the home medical computer programs and the effect of the article caused concern to Robert McCrindle, MP, Cons, Brentwood and Ongar. For was there not a danger here that the new technology could lead to real medical problems?

He wrote the Secretary of State for Social Services making the two following points:

1. There is a possibility that people will use home computers like medical books and will attempt to treat themselves — conceivably a dangerous practice.
2. There appear to be no regulations regarding the accuracy and impartiality of advice contained in these computer programs. Should an independent body not be involved so that the highest standards of medical practice are adhered to in the production of the programs?

Since then, in government circles, the matter has rested. But in home computer circles resting is the last thing that any matter ever does. There are now more medical programs than ever on the market. Are they worthwhile? Are they potentially dangerous? More to the point for many readers of *PC*: can a computer ever really replace a doctor? If it can, then there is money to be made.

It is tempting to start by thinking in terms of expert systems. You could have an expert system in the field of medicine, load that on your micro, and there you have it: a doctor in the house. Such notions were largely fostered by some of the early expert systems which were written specifically to deal with problems in medical diagnosis. The diagnostic capabilities of systems like Mycin and Puff were reckoned to be the equal of most competent physicians.

But to start at expert systems is to start at the wrong end of the problem. A much better approach is to go into a bookshop and work from there, devising a broad categorisation of things which might be possible on a home computer along with the benefits and costs involved.

You could start with the categories Text, Tables and Diagnostics. If you buy a book on medicine you have text. This text could easily be transferred to a computer, given enough memory. Given the availability of graphics, pictures are possible too. The information is presented serially and so involves little manipulation by the computer.

From the same bookshop you could buy a volume of tables. They might include ideal height/weight charts, average life-expectancy tables for certain groups of the population, and so on. Obviously, they can also be placed into a program.

Finally, you can go to the bookshop and buy a book on medical diagnosis — and here comes the crunch. Exactly how an experienced practitioner reaches a diagnosis is still something of a mystery. And yet this is the big dream: a computer than can do this infallibly every time or, at least, as infallibly as do Mycin and Puff.

The circumstances in which good diagnostic programs have been written are very tightly constrained. Typically, they work in fields where a good deal is already known so that a human expert is available to guide the programming. They work in very narrow fields, such as in the area of meningitis infections with Mycin, or pulmonary diseases with Puff.

A general-purpose doctor program would present very serious difficulties of implementation. The Tables and Text or lecturing elements of doctoring are feasible, although a little expensive in storage media. The real problem is diagnosis. No existing

system can examine you thoroughly via a keyboard. Even if suitable data were available, the diagnosis routines would be enormously complex.

With the current state of the art the greatest chance of success lies with those programs that have a limited aim in mind and execute that aim well. We reviewed five medical programs which are currently available in the U.K. Having done so it appears possible to answer Robert McGrindle's two main points:

1. People may come to use home computers like medical books and may, on the information they contain, attempt to treat themselves. However, the same criticism can be levelled at medical books.
2. As far as regulations go, the same appears to hold for medical programs as exists for medical books — that is, none at all. There is a *de facto* set of regulations which states that a product gains in credibility and sales if it is underwritten by an acknowledged expert in the field. In the programs reviewed there is little evidence of any medical advice which appeared to be unreasonable as compared with, say, a home medical encyclopaedia.

Help

The idea behind the Health and Exercise Lifestyle Program, Help, is that most people are not all as healthy as they might be. If they were to be made aware of this and the risks they run, then they might try to improve their general all-round levels of fitness and health.

Help originated in the mind of Flight Lieutenant Walter Williamson, a PE officer at RAF Leuchars. It was his task to ensure air crews remained fit while living a life which consisted of long spells in the mess punctuated by brief Mach 2 scrambles in their Phantom jets. If you can tell fighter pilots how to keep fit then, the theory goes, you can tell anyone how to keep fit.

Help comes on a single disc with a substantial manual. To run it you initialise a blank disc to hold the data and then boot up the program disc. The first part is intended to assess how fit you are. A questionnaire identifies any risk areas in your lifestyle and suggests what you might do to reduce these risks. The second part offers a tailor-made exercise program which is designed to match up with the information gleaned from part 1, coupled with your own personal tastes and inclinations in the matter.

It is possible to produce a computer program which will give a fair assessment of risks because a lot of published research exists in this area. Help seems to establish risk factors adequately, though it may be a little sparse in detail.

Help establishes risk factors in two groups: inherent background factors and lifestyle factors. Inherent background factors include your sex, age, family history and blood pressure. It is a little disappointing that the only question which Help asks about family history is whether or not any of your grandparents has ever died of a stroke, and at what age. It is relevant information, but it would also be useful to know whether the subject's parents were still alive or, if they were not, at what age they had died. If you want to live to a ripe old age the best thing you can do is to have long-lived parents.

Lifestyle factors include your percentage of body fat, smoking habits, exercise habits, and stress levels. The manual points out that it is not what you weigh that counts, but how much of you consists of fat. A pair of calipers is provided with the Help package with which you measure the thickness of the layers of fat at various points on your person. From these measurements Help calculates the percentage of fat on your body.

Smoking habits are asked about in a straightforward fashion, as are exercise habits, but the question about stress levels begins to provoke some doubts. The program asks you whether your stress level is low, moderate, or high and receiving medication, which seems a little vague. Equally imprecise is the question as to whether you have a small, medium or large frame size. There are precise details in the manual of how to work out both size and stress levels, so why couldn't they be incorporated into the program? It gives you the feeling that Help is less a computer program with accompanying manual than a manual with a program thrown in as an afterthought.

Having answered all the questions honestly and truthfully I was rewarded with a summary display which showed that I should cut down on my smoking, reduce my fat level and reduce the amount of stress in my life.

I decided there and then to improve my general fitness levels, and went on to see what programme of exercises the second section would prescribe. From the 150 possible activities available I was offered climbing trees and playing netball. I had already stated my sex and age — male, and in the second half of life — though there is little doubt that if I did spend 40 minutes three times per week in climbing trees I would probably be a better person for it. There were also some more congenial activities to choose from, including walking, pool and billiards, which are all recommended for muscular development.

Health profile

If you have a printer, Help will output summary details of your health profile, proposed activities and a neat progress chart showing how your weight, fatness and aerobic capacity have developed. The data disc for a two-drive system has the capacity to hold details of up to 50 different people. That is really the clue to the product's main market, which is clubs and gymnasia.

If you just want to get fit the manual has a handy bibliography at the end. From it you might choose, say, *Physical Fitness 5BX and XBX* from Penguin Books at £1. When it comes to the nitty-gritty of what you should really do to get fit, this book offers rather more detail than does Help.

The recommended method for quitting Help is to continue until the program reaches the point at which it asks you to input your name, and then to switch the machine off. Switching off at any other point can have unpredictable results. A more orderly method for exiting from the program is called for, as is a way of quitting part-way through the program. Having run the program a few times, I eventually reached a stage at which I wanted to quit and simply removed the disc from the drive. Since then, the program has never worked again. This is, of course, my own fault for not following the instructions in the manual when using what must be a delicate product.

First Aid

The aims of the First Aid program are pretty modest. It has been produced in consultation with the British Red Cross Society and St John's Ambulance to teach the basic elements of first aid for use in emergencies. The program is aimed specifically at young people aged 13 and over.

The program offers you four initial options. The first is Study Subject, which provides a simple introduction to the workings of the human body, the aims of first aid, and common emergencies which can arise. It is all very basic but useful too. There really appears to be nothing on this program with which anyone could argue. The workings of the body are illustrated by a straightforward animated diagram of the heart-lung cycle, which is very nicely done and thoroughly enjoyable.

The second option, Revise any Part, breaks the introduction down into nine subsets. You can run through the procedures for, say, shock without having to go through the whole works again. The third section, Test Yourself, offers a quiz on the nine sections. You can answer questions in plain English; your score is marked up for each of the nine sections to give an overall score. The final section is simply an exit from the program which tells you what your total score was, admonishes or congratulates accordingly, and advises you to join a local first-aid group.

The review program for the 16K ZX-81 had a few bugs. The animated diagram of the heart-lung cycle was shown incorrectly when entered from the second option. The calling Gosubs which bring up the graphics display had been misordered with the result that a bleeding artery was shown at the wrong point in the story. Parts of the lungs also appeared prematurely.

Some improvements could also have been made to the presentation of the answers and scores in the Test Yourself

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section. The score shown is the total score to date, when it might have been preferable to show the score for that particular question together with the user's answers and the right answers.

The fact that answers can be given in free text English does not mean that the program has a natural-language front end.. The program simply scans for keywords and phrases in the answer to give a verdict of wrong, nearly right or right.

Such faults as existed would normally cause a package to be dismissed as unreliable. However, in this case the aims of the package are so straightforward that it is still worth buying. At the price, it is a thoroughly commendable effort.

The same program in its 48K Spectrum version did not contain any bugs. It is in glorious Spectrum colour too, so blood changes satisfyingly from red to blue as it passes through the lungs.

Home Doctor

The Home Doctor series was written by Dr Vernon Coleman, a general practitioner and medical author, and Russell Smith, technical director of Eastmead Computer Systems. The aim of the programs is to help prospective patients to determine whether or not they should visit their doctor and, if so, whether the matter is urgent or routine.

The six cassettes are entitled: Basic Medicine, Mainly for Women, Mainly for Men, All About Children, How Healthy Are You? and 101 Home Nursing Tips. Together they contain over 100 separate programs, so it was clearly impossible to review all of them in detail. We took a close look at two: Basic Medicine and How Healthy Are You?, both in the versions for the 16K ZX-81.

The first program on each cassette is an index which starts with some words of caution to the effect that a computer is not a full substitute for qualified medical attention. A short list of questions then determines whether or not you have any major warning signs of illness. If you answer yes to any of them you should see a doctor without delay, and the program goes no further.

Otherwise, the index to programs contained on each cassette is displayed. The Basic Medicine cassette contains 17 programs, the first of which deals with abdominal pain. You are asked a series of Y/N questions. If at any time the program detects something from which it can draw a conclusion it either advises you to seek emergency medical help through your doctor within some specified time period, or simply suggests that you leave the matter for a specified time to see if the symptoms disappear.

The programs do not, in general, suggest

The problem of diagnosis

When thinking of applying the micro to medicine many people confine themselves to the problem of diagnosis. If a computer could be programmed to diagnose illness, then that would undeniably be worthwhile. It might be preferable to talk in terms of "mechanised diagnosis". If such a method could be devised it could be implemented on a computer; if no such methods exist then it can't.

The problem is the broad statistical one of classification or discrimination. Given a set of observed data on some object, the problem is then to assign that object correctly to one of k categories. As such, it is obvious that the technique is in no way limited to medical diagnosis, medicine, or diagnosis. It is a problem of classification and very little else.

In the medical field several examples exist of mechanised diagnosis. In 1959 Crooks, Murray and Wayne devised a method for diagnosing thyrotoxicosis. The end result was a procedure which consisted of a simple check-list:

Does the patient have palpitations? Score 2 for Yes
Does the patient have a palpable thyroid? Score 3 for Yes, score −3 for No.
Does the patient have a decreased appetite? Score −3 for No.

At the end of the full question-and-answer sequence the score is totalled. If it is over a certain figure the diagnosis is thyrotoxicosis, below a certain figure the diagnosis is the absence of thyrotoxicosis, and in between there is uncertainty. The method worked well, as have methods devised for other circumstances.

Clearly, a process like this could be computerised, although in many cases the rationale behind such work has been to get better diagnoses out of human doctors. The problem really lies in establishing a suitable discriminant function for each illness. The simple scoring system for thyrotoxicosis is deceptive: just because it looks easy to use it would be wrong to suppose that it was easy to derive the scores in the first place. Such a derivation would usually require at least a graduate-level knowledge of statistics as well as some knowledge of medicine. Worse news is yet to come, because even if one method of carrying out such classifications were given it would almost certainly not be appropriate for the diagnosis of every type of illness which came along. This is because the methods used are essentially statistical and, as the nature of the data changes, so does the precise nature of the statistical techniques required to handle them.

Apart from the traditional approach of discrimination, which relies on classical statistics, there is the currently more popular approach of Bayesian statistics. Each illness is presumed to have a certain probability of being present, called the prior probability, which is continually modified through the answers to a series of questions. In practical terms this approach has a lot to recommend it but it is still possible to come across problems. They tend to centre around the fact that different illnesses require slightly different methods of analysis in statistical terms.

It all adds up to a very difficult situation for anyone who is trying to adopt a general-purpose system for medical diagnosis. The problem is usually solved by a combination of two methods: a reasonable theoretical compromise with regard to the statistics used, and limiting the field of the program's expertise to a class of illnesses with similar statistical properties.

When it comes to providing a system that could be used on a home micro as a doctor substitute the problem becomes even worse. In a medical setting, those who are using the system can surely be assumed to understand the questions they are being asked and understand the limitations of the method the machine is using. This may not be the case for the casual user. Do you know whether you have a palpable thyroid?

One solution is to produce a program which allows for uncertainty in the users' answers so that they can at least reply "Don't know". Obviously, if the user answers "Don't know" to every question then the program gets nowhere. The bulk of the questions must be intelligible to the layman. Intelligibility is gained at the expense of information value: everybody could understand a question such as: "Do you feel a bit rough?". But what, exactly, could be inferred from such an answer compared with the more precise questions which a trained medical practitioner might be able to answer.

any specific treatment nor do they normally offer any specific diagnoses. Occasionally a diagnosis will be suggested as likely: for instance, the Breathlessness program observes that "stress can cause breathlessness" or, at another point, "anaemia is possible". Suggestions for treatment are made occasionally as, for instance, when the Abdominal Pains program advises a light diet and abstinence from alcohol and tobacco for 24 hours when your responses have led it to believe that you may have indigestion.

Symptoms

The Basic Medicine cassette proved to be comprehensive in intent, but suffered a little from the odd shortcoming. In the Breathlessness program replying Y to the question "Do you have a wheeze?" leads the program to announce "Asthma should be excluded". The same result is obtained by answering Y to the question "Do you have a cough?". On most of the tapes the assumption on running a program seems to be that the user is suffering from the symptom associated with the program. So running the Breathlessness program indicates that the user is, in fact, breathless. If a patient is both breathless and wheezing, or breathless and coughing, it might be inadvisable to exclude the possibility of asthma. Perhaps that program line should have read "Asthma should not be excluded".

Another question on the Basic Medicine tape reads

```
Have you been unable to pass urine
  recently?
Is there any abdominal swelling
Enter (Y/N)
```

Possibly there are circumstances in which there is a necessary connection between the inability to pass urine and abdominal swelling. But more likely these two items were intended to be asked as separate questions in their own right, and a little miskeying has struck the program here.

More modest

Many users may know the answer to the question "Do you have a hernia?" Yet it is quite possible to find a patient with abdominal pain who has a hernia but does not know it, so it would have been useful to identify a hernia. Similarly the Accidental Injury program puts the question "Could there be a fracture (break) of any bone?" The much more modest First Aid program scores by helping to teach users how broken bones may be recognised.

No clear line is drawn between symptoms, diagnoses and treatments in the Home Doctor series. It would have been more useful to interrogate the user about symptoms rather than possible diagnoses, unless sufficient information were given to the user to enable his or her judgements on possible diagnoses to be somewhat more informed.

A major drawback of the series is that it is on tape. It can take a lot of patience to find, say, the 16th program on a tape. Yet the Electric Shock program asks

```
Is the victim unconscious or breathing
  abnormally?
```

If you reply Y then you will see the message

```
Run the program on unconsciousness
```

Nobody in their right mind would coldbloodedly carry out this procedure at a time of emergency. Even a book would be much quicker.

If the programs were available on disc the picture would be quite different. But even on tape, the programs would be much more usable if they were linked in a more efficient way. For instance, once the program has offered a suggestion it ends and has to be re-entered with a Run command. It would be better if it remained running all the time, returning at suitable points to a main menu from which you could choose to exit if you felt like it.

How Healthy Are You?, tape 5, contains programs 71 to 83 and is designed to assess a wide variety of aspects of health from physical fitness through to a vision test. The Physical Fitness program lacks the depth of Help but it also lacks Help's high price. Just for the record, it advises everyone to take up walking, swimming, cycling, hill climbing, tennis and squash.

Missed chance

The program that deals with weight problems appears to miss an opportunity to carry out some arithmetic. It displays a standard height and weight chart from which you can read off your ideal weight. Help's approach of asking you for your height, weight, frame size and body-fat measurements appears to make better use of a computer's abilities in this respect.

This tape contains very little with which anyone would disagree. The program Eating Wisely advocates less fat, cholesterol, salt and sugar, and more fibre. Stress Assessment presents a questionnaire of the sort found in the Help manual. Handy hints and tips seemed to be the order of the day.

Vision Test, the final program on this tape, displays two sets of letters on the screen and asks you to input the height in centimetres of your TV screen. The program calculates exactly how far away from the screen you should stand and still be able to read either the big letters or the small letters. I passed the first test with flying colours but was unable to carry out the second unless I had been willing to make extensive use of the back garden.

The Home Doctor series has not been very successful in transferring to computer cassette information which has traditionally been contained in home medical books. When it comes to giving hints and tips, a book is a much handier device to access in the current state of the art. If the subject does attract, perhaps you should try one cassette before splashing out on the full set.

How long have you got?

This program is little more than an application of standard medical statistics on life expectancy. After asking you a series of Yes/No questions the program tells you how long you have to live. Of course, it is impossible to make specific predictions about an individual's lifespan, a point which the program makes clear right at the beginning.

The program describes itself as a "fun guide", but, deep down inside there is a very solid core of theory. Life-insurance companies, for instance, make their money by guessing when an individual will die, and over the years a large body of data has been amassed which ensures that the guesses are as educated as possible.

To start with the program assumes that you will live to be 75. It then proceeds with its question-and-answer session and knocks off or adds on a few years according to your replies. A Yes answer to a query about my smoking knocked a year off my life, and the fact that I had nicotine-stained fingers knocked off another two. I smoke between 20 and 40 ciggies a day, which knocked off another three years, and I drink alcohol, which cost another year. A few more questions like that and I would have given up all ideas of buying any long-playing records.

In a self-centred, inward-looking kind of way the program is fun. It certainly is not the sort of program you tend to abandon half-way through. It also tends to drive home the effects of the way you live, and if you ran the program often enough you might start to think about modifying your habits in order to increase your score. It would, after all, be very easy to argue that those who like playing computer games in which the aim is to achieve a high score might gain more real benefit from this program than from one which merely led them to increase the accuracy of their aim with a laser cannon.

No initiative

On the programming side there are some unsatisfactory features, mainly concerning the structuring of some questions. For instance, when the program asks if you are overweight by 7lb. to 14lb. it would have been nice to see it show a little more initiative. After all, how many people know just how much they should weigh? A few questions regarding height, weight and frame size could have removed a lot of doubt from this question and made the computer earn its living by doing some calculations of its own.

Criticisms of the program arise because it deals only with yes/no answers, which are not always the most natural form in which to input certain items of information. But all in all it is an addictive program which

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benefits from aiming to crack one simple problem rather than trying to be everything to everyone.

The Complete Guide to Medicine

The Complete Guide does not attempt any sort of medical diagnosis and makes few suggestions as to specific treatment. It is really a computerised medical primer of the sort you might once have bought in book form if you had wanted to know how the body works. This is a much more limited aim than the Home Doctor series and possibly one which makes less use of the computer's potential.

Given the difficulties which are involved in making computers work there is a lot to be said for defining a reasonably modest aim and achieving it. Here you have a computerised book, and a pretty good one too. It comes on a single cassette containing seven programs: Reproduction; Skeleton, Nervous and Intestinal System; Circulation and other internal organs; Keep Yourself Fit; What to do when Things go Wrong; Home Nursing Tips 1; and Home Nursing Tips 2.

The programs are much easier to use than the Home Doctor tapes. After loading the first program on side 1 you are prompted through the rest of the tape with simple messages. Because the programs are, effectively, a book replacement it is adequate to go through the things serially.

Each section consists of a screen display which is divided into two halves. A box of text on the left is complemented by a graphics display of explanatory diagrams, some of which are animated. The graphics are good, and the combination of text and graphics makes the whole thing very easy to follow.

Each display is usually continued by pressing C but some sections have another option, called Microzoom, which takes a small part of the graphics display and shows it in more detail.

The most distinctive programs by far were the first four, which occupy side 1. Together they describe the workings of the human body. Among the particularly nice features were the descriptions of the skeleton and the heart diagram. The Microzoom shows the one-way valves in blood vessels and the consequences of poor valve operation.

The second side gives some comprehensive hints and tips for dealing with home nursing. It tells you how to stock your medicine cabinet, how to administer prescribed drugs and it gives some useful hints on drug side-effects.

Vivid

If all The Complete Guide had to offer was its second side you would be better off with a book. But side 1, with its mixture of text and animated graphics changes the story. It really is much more vivid than a book could ever be.

There is very little to complain about in the way the package has been programmed. When describing the internal organs all goes well until the female breasts appear on the screen. At which stage the question appears next to them

Do you really need this? Y/N

What can you say? The review copy was a pre-production version, so the program which finally appears in the shops may incorporate some further refinements.

Wellness Check

Wellness Check is a program devised by the Rhode Island Department of Health to check on individuals' wellness — try looking that one up in your dictionary. It consists of a list of 47 questions with multiple-choice answers from which it calculates risk factors and provides an individual printout showing those areas of a person's lifestyle which require modification.

That sounds like pretty familiar stuff, but the thinking behind it is very different to that behind the other products reviewed here. For a start, it is not really intended for the home user at all. It is intended as part of a community program in which large numbers of people are processed.

If you are going to carry out that kind of screening with a single computer program, you might as well start amalgamating the results you obtain so that different sections of the population can be readily compared with other sections. This is just what Wellness Check allows you to do. It has been used so far on over 20,000 people, so there is a fairly large body of comparative answers available for each of the questions. Wellness Check has been used in the U.S., Canada and West Germany. No U.K. distributor has been found so far.

The method of working is to give each subject a booklet which contains the 47 questions and an optical mark reader card on which they score their answers. The OMR cards are fed into the card reader and an individual printout is given to the subject by way of return. It is possible to run the system via the screen without the card reader, but doing so is about as user-friendly as reading a core dump. There is no way of diverting the individual printed assessments from the printer to the screen, so you either get a printed report or nothing.

Some of the questions are not entirely sutiable for the U.K. For instance, there are questions designed to discover if the respondents are at risk in their car-driving habits. They ask if you always wear a seat belt, if you ever drive under the influence of drink or drugs, and whether your insurance has ever been cancelled. With the exception of the last question it may be that the law of our land removes the necessity for such questions. In fact, it could be argued that health care in this country is so much less fragmented than that in less civilised places that screening individual communities at this level is of less importance. British health authorities might still be interested in Wellness Check simply because of the availability of comparative data.

Systems and suppliers

	Runs on	Format	Price
Help	Apple II	disc	£60
First Aid	ZX-81, 16K Spectrum, 48K BBC Model B RML 480Z	cassette	£4.49
Home Doctor	ZX-81, 16K Vic-20 plus 3K RAM	cassettes	£6.75 each or £33.75 for set
How long have you got?	ZX-81, 16K and 48K	cassette	£3.45
The Complete Guide to Medicine	Spectrum, 48K	cassette	£6.90
Wellness Check	IBM PC, Apple II Tandy Models II, 12, 16	disc	$250

Suppliers

Help Gate Microsystems Ltd, The Nethergate Centre, 35 Yeaman Shore, Dundee DD1 4BU

First Aid Network Computer Systems Ltd, 39 Bampton Road, Luton, Befordshire LU4 0DD

Home Doctor, How long have you got?, The Complete Guide to Medicine Eastmead Computer Systems Ltd, Eastmead House, Lyon Way, Camberley, Surrey GU16 5EZ

Wellness Check State of Rhode Island and Providence Plantations, Department of Health, Cannon Building, Davis Street, Providence, Rhode Island, U.S.A.

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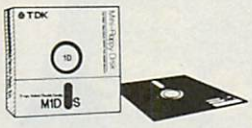

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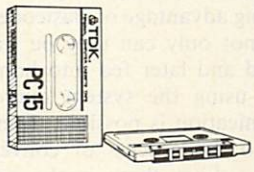

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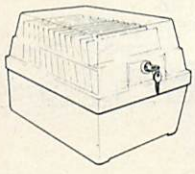

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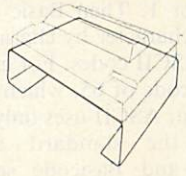

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Programs

SAILORS listening to BBC Radio 4 just after the late shipping forecast recently may have been annoyed to discover an apparent fault in their radios which would suddenly burst into a wild banshee cry. This two-tone high-pitched whine will be familiar to anyone who has loaded programs from cassettes: it is Basicode, Basic's equivalent of Esperanto, and it is broadcast as part of BBC Radio 4's new computer magazine programme *The Chip Shop*.

The big advantage of Basicode programs is that not only can they be transmitted, recorded and later fed into home micros, but by using the system micro-to-micro communication is possible. There are two stages to the process of conversion into Basicode. First there is the problem of compatibility when transmitting data. Micros store programs on audio tapes by converting the bits — binary digits — into one of two frequencies, representing a binary 0 and 1 respectively. But the exact details and frequences of audio signals generated vary widely.

Frequencies used

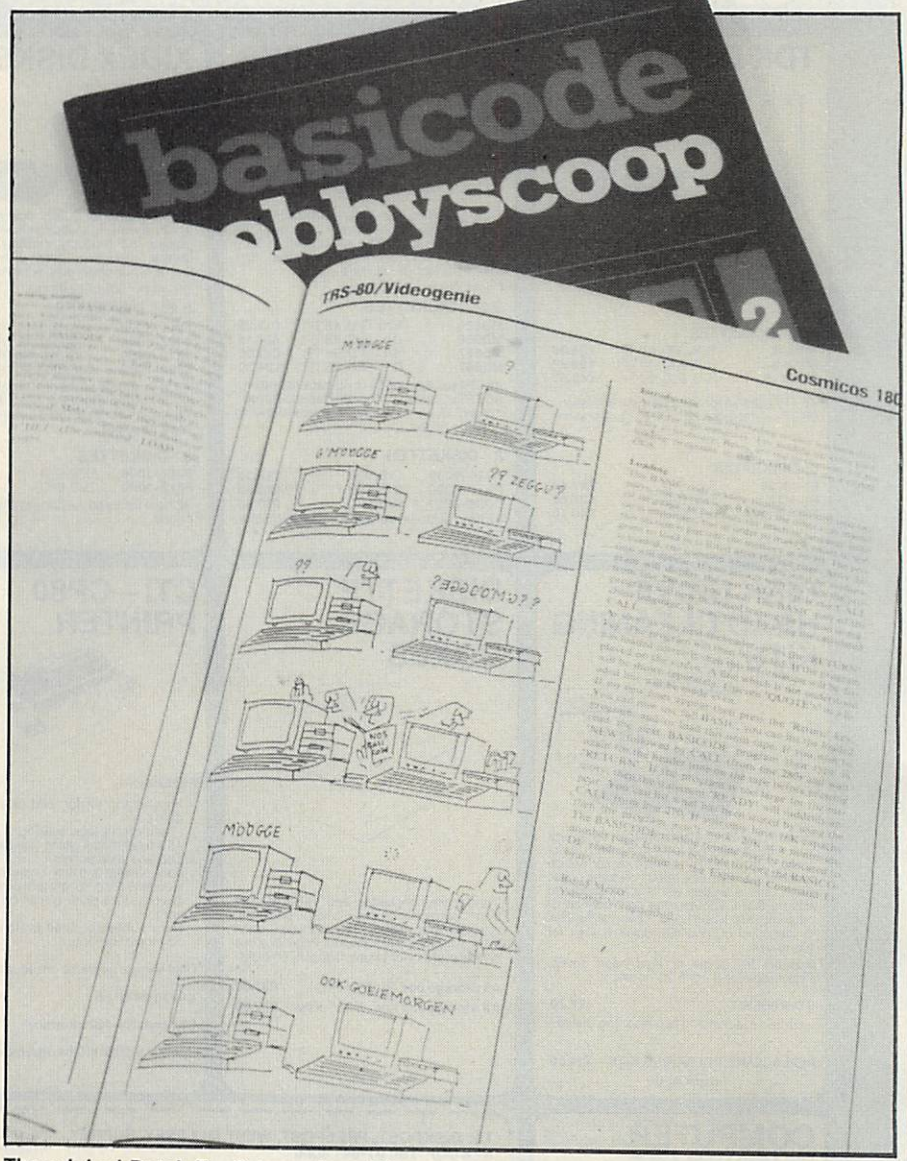
Basicode first standardises the frequencies to be used at 1,200Hz for 0 and 2,400Hz for 1. Then Basic programs are converted character by character using the standard ASCII codes. For example A has an ASCII code of 65, which is 1000001 in binary form. ASCII uses only seven bits to represent the standard alphanumeric characters and Basicode sets a further eighth bit to be 1. After adding a logical 0 start bit to mark the beginning of the string and two logical 1s as stop bits to signal the end, the Basicode audio translation of the colon character appears as in the diagram below.

Using this Basicode translation technique, any Basic program can be transferred to another machine running Basicode. There remains, of course, the problem of dialects. Most machines have some quirk in their Basic implementation making them incompatible with other Basics.

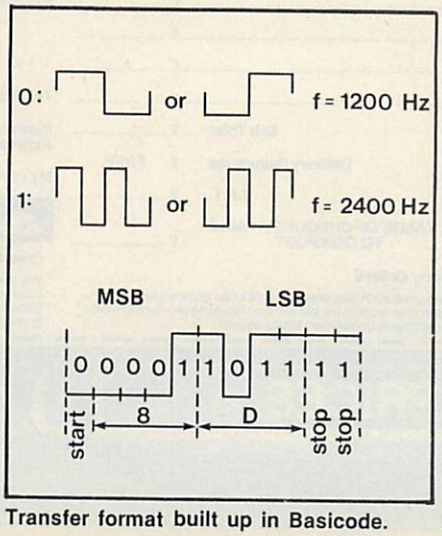
Levelling down

Basicode's solution is drastic but it works. A subset from each machine's set of Basic commands like Goto, If-Then and Proc, which are common to most popular micros, has been chosen as standard. This is a levelling-down process, and what is gained in breadth of applicability is paid for in the reduced complexity of the programs. Machines for which Basicode translation programs can be run include the Apple, BBC Micro, the Commodore family, CP/M computers and the Tandy Models I and III. The permitted Basic commands and operations are listed in table 1.

A number of common operations are absent from this list. They include features such as clearing the screen and generating random numbers, the syntax for which varies from computer to computer. To



The original Dutch-English version of the Basicode 2 manual.



Transfer format built up in Basicode.

Line-number scheme

The following is used to build up a Basicode 2 program:

Lines 0-999: standard routines. These routines are different for each computer and are therefore contained in the translation program.

Line 1000: first line of the Basicode 2 program. It must be in the form:

1000 A = (value): Goto 20: REM program name

value is the maximum number of characters that can be used by all strings together. Line 20 is used to reserve memory space for the strings in those computers which need it.

Lines 1010-32767: the main program. There are no restrictions on this section, except that line numbers above 32767 are forbidden.

on the air

Glyn Moody looks at how radio programmes for hobbyists have prompted the rise of Basicode.

provide them in a machine-independent way, special subroutines are constructed. So instead of writing CLS to clear the screen, Gosub 100 is used. The machine-dependent routine is then called at line 100.

There are a number of these special subroutines, all stored by Basicode convention in lines 0 to 999 of the Basic program. The main program itself then begins at line 1000, and can only use the permitted commands of table 1 plus calls to Gosub routines.

Typically the subroutines and translation programs are written in machine code. After the input program is translated, lines 0 to 999 are appended to provide the subroutines, which can then be called by the main body of the program.

Additional restrictions on the structure of a program are that the screen dimensions are fixed at 24 lines by 40 characters, that numeric variables are real and single precision, and that the name of a variable can have a maximum of two letters. There are also a number of reserved variables used in the standard subroutines.

ABS	LOG	TAB
AND	MID$	TAN
ASC	NEXT	THEN
ATN	NOT	TO
CHR$	ON	VAL
COS	OR	+
DATA	PRINT	–
DIM	READ	*
END	REM	/
FOR	RESTORE	↑
GOSUB	RETURN	
GOTO	RIGHT$	=
INT	RUN	<
IF	SGN	>
INPUT	SIN	<>
LEFT$	SQR	<=
LEN	STEP	>=
LET	STOP	

Table 1. Basicode's permitted Basic commands and operations.

Basicode

- Basicode is available in the U.K. for the Apple II and IIe, BBC Models A and B, Commodore 64, Pet and Vic-20, Sharp MZ-80A, Sinclair ZX-81, Tandy and the Video Genie.
- The Basicode kit, which includes subroutine programs on tape and a handbook, is available from Broadcasting Support Services, PO Box 7, London W3 6XJ for £3.95.
- *The Chip Shop* is broadcast at 5pm on BBC Radio 4 on Saturdays, and is repeated in an extended version at 11pm on Tuesdays. Basicode programs are broadcast after the 12.15am shipping forecast in the early hours of Sunday, Monday, Wednesday and Thursday.

Basicode arose out of a desire by Teleac — the Netherlands' equivalent to the Open University — to supplement its computer course with software which could be distributed to students throughout the country. In 1979 Teleac aproached the Dutch domestic service NOS and the first broadcasts of software, though only for specific machines, were given by the hi-fi programme *Hobbyscoop*.

In response to public pressure for software that could be used by a wider range of micro enthusiasts, an engineer at Philips developed a prototype of Basicode consisting of the translation program only. Basicode 2, which also includes the initial routines and standard command set, was first broadcast at the beginning of 1983.

The original Basicode system was also used for a series of experimental broadcasts by *Media Network*, a programme produced for Radio Netherlands, the external services arm of NOS. These short-wave transmissions proved highly successful, with signals reaching as far afield as Australia and the east coast of America.

Partly as a result of the interest generated by these broadcasts, *Media Network's* producer, Jonathan Marks, has become increasingly involved in promoting Basicode overseas. Today, a sister programme *Radioactivity* is supplied on a transcription basis to over 155 educational stations in countries such as Sweden, America, Italy and the U.K. *Media Network* is broadcast at 18.40 GMT on Sundays at 747kHz.

The attitude of the Dutch radio service has always been avowedly evangelical. Programs are free, and there is a conscious attempt to use this new means of transmitting software to get people to think about computers as more than just a black box. Programs have been very largely educational, and have been broadcast with the additional hope of encouraging micro owners to talk to each other and not just to their machines.

Sole rights

To further these aims in this country, NOS has entered into an agreement with the BBC granting it sole rights in the U.K., with the proviso that Basicode must be offered on a cost-only basis.

Although the BBC now broadcasts Basicode as part of its new *Chip Shop* series on Radio 4, the first transmissions in the U.K. using this system were by BBC Radio Wales last autumn. More recently, Radio Wales' programme *The Micro Show* broadcast purely machine-specific programs catering for the Spectrum and the BBC Micro among others.

The distinction of the first software broadcast in Britain probably belongs to BBC Radio Leeds, whose programme *Abacus* transmitted software on an experimental basis back in October 1982. *Abacus* is still around, and goes out at 6.45pm on Tuesdays. Other local stations that have shows with software include Radio West's *Datarama* at 5pm on Sundays, and LBC's *Young London* programme, also on a Sunday afternoon, which broadcasts software at about 3.30pm.

Narrow audience

The use of machine-specific Basics — and in the near future machine codes themselves — will enable more complex programs to be broadcast, though necessarily to a narrower audience. This exacerbates the problem that audio tones grate on the ear, and there is clearly a limit to the amount that people who are not interested in recording software will tolerate. *The Chip Shop* has solved this problem by tucking its broadcasts safely away after midnight.

The software that is broadcast — with or without Basicode — is offered free. BBC stations are particularly concerned that there should be no commercial tie-ins, and that programs are only broadcast when relevant, not merely as a gimmick. So it is not surprising that educational uses tend to predominate.

Programs scarce

Some British producers of programmes on micros broadcasting free software have expressed concern that suitable computer programs might prove scarce, though the Dutch experience suggest that such fears are groundless. A competition launched there recently attracted 1,500 Basicode programs. Now a foundation is being set up in Holland to promote Basicode and publish a quarterly selection from the many programs that are sent into *Hobbyscoop*. All sales will be at cost price.

It is estimated that out of the 100,000 computer hobbyists in the Netherlands, some 60,000 have *Hobbyscoop's* Basicode. It is widely used to communicate between different machine user groups. In the U.K. *The Chip Shop* reported that 12,000 Basicode kits went out even before the first broadcast of the series, and the figure rose to 40,000 after the first broadcast. Basicode may be limited as a language, but it cannot be a bad thing if it helps computer users to communicate with each other.

View printer driver

T L Morris has writen a machine-code driver which links Acornsoft's ROM-based word processor to an Epson FX-80 printer.

THE POTENTIAL of the BBC Micro as a word processor is rapidly being realised by the development of compact and powerful ROM-based programs. Acornsoft's View is one of the best of those currently available but it does suffer from the sort of problems that are inevitable in the design of complex software that must interface with a range of peripherals.

Ultimately, the objective of a word processor is to convert the text held either in the computer memory or in a magnetic storage medium into the printed word. This poses a problem, as the word processor has to be able to instruct the printer to deal with the text. A program has to be written which links the word processor to the printer: such a program is called a printer driver. Until recent developments involving dot-matrix printers this was a relatively easy matter. Although several different types of printer were used only a few facilities were available. For this reason and also because of the importance of using the minimum of the computer memory for the operation of the word processor, only one page — &0400 to &04FF — was reserved for the printer driver.

The appearance of the Epson FX-80 with its enormous range of facilities was another matter. This was not unexpected, as the dot-matrix type of printer had for some time been threatening to offer a wide range of type styles which would be accessible under the control of driver software. The limited range of options available in Acornsoft's printer driver for the earlier MX-80 testifies to the difficulty of cramming type-style options into a driver which has to cope with the proportional spacing of characters at the same time.

Despite the problems the FX-80 created there was one pleasant surprise in the form of a proportional mode in which the character spacing is dealt with by the printer, leaving the printer driver free of the problem. Nevertheless, 128 type styles are available, if you include the Pica and the Elite options. In writing your printer driver to link View to the FX-80 the different typefaces and special effects are best accessed via two separate drivers; one for the pica and the other for the elite typeface.

Main factors

Among the factors to be considered when writing the drivers, the following are the most important:

- The limited amount of memory available for the driver.
- Advanced features such as reverse paper feed and backspace are built into the printer carriage and the movement of the print head respectively. They are of immense value in a driver designed to cope with the demands of a technical script, and any serious attempt at a printer driver ought to include them.
- Single-sheet printing demands the optional deselection of the end-of-paper alarm and cut-off.
- Only two highlight characters are used by View and they are permanently present in the screen display. The inclusion of a large number of facilities would fill the screen with similar highlight characters, making it awkward for you to make an accurate selection.

Eight switchable highlights, many of which could be used in combination, are therefore used together with backspace and the out-of-paper deselect. Table 1 shows descriptions of the chosen highlights accompanied by the printer control codes and their hexadecimal representation. True subscripting and superscripting are available for the first time on a printer of this type because of the availability of reverse as well as forward paper feed.

The use of backspace also allows the subscripting and superscripting to be placed directly underneath one another. The switchable highlights are accessed through the normal View HT embedded

Listing 1.

```
  10 OSWRCH=&FFEE
  20 OSBYTE=&FFF4
  30 assemble=&3400
  40 last_highlight=&87
  50 accumulator_store=&4FC:
     flags=&4FD:control=&4FE
  60 FOR PASS%=0 TO 3 STEP3
  70   P%=assemble
  80   [OPT PASS%
  90   .jump_table
       .
       .(see assembled version for
       .comments etc.)
1050   JSR OSBYTE
1060   RTS
1070   .offset
1080   ]
1090   P%=P%+17
1100   [OPT PASS%
1110   .data
1120   ]
1130   NEXT PASS%
1140 !offset=&0A070400
1150 !(offset+4)=&1E17150E
1160 !(offset+8)=&2F2C2925
1170 !(offset+12)=&413B3933
1180 ?(offset+16)=&47
1190 !data=&FF012D1B
1200 !(data+4)=&1BFF341B
1210 !(data+8)=&571BFF47
1220 !(data+12)=&701BFF01
1230 !(data+16)=&EAEAFF01
1240 !(data+20)=&1BFF0FEA
1250 !(data+24)=&531B0C6A
1260 !(data+28)=&4A1BFF00
1270 !(data+32)=&01531B09
1280 !(data+36)=&002D1BFF
1290 !(data+40)=&FF351BFF
1300 !(data+44)=&1BFF481B
1310 !(data+48)=&1BFF0057
1320 !(data+52)=&EAFF0070
1330 !(data+56)=&1BFF12EA
1340 !(data+60)=&541B0C4A
1350 !(data+64)=&096A1BFF
1360 !(data+68)=&1BFF541B
1370 !(data+72)=&FF501B40
```

```
   >.....*.....*.....*.....*.....*.....*.....*.....*.....*.(
   *  sets italics (default HT 2 is 129)

HT 2 132
   *  sets proportional mode

HT 2 131

CE _*a centred, underlined, proportionally spaced, enlarged title in italics*_
```

Figure 1. Use of mixed highlight effects in View.

NO HIGHLIGHT
no highlight

HIGHLIGHT 1 128
highlight 1 128
Underline

HIGHLIGHT 2 129
highlight 2 129
Italic

HIGHLIGHT 1 130
highlight 1 130
Double strike

HIGHLIGHT 2
highlight 2
Enlarged

HIGHLIGHT 1 132
highlight 1 132
Proportional mode

HIGHLIGHT 2 133
highlight 2 133
Condensed

HIGHLIGHT 1 134
highlight 1 134
True superscript

HIGHLIGHT 2 135
highlight 2 135
True subscript

$5Fe^{2+}_{(aq)} + MnO^{-}_{4(aq)}$

Highlight effects in Pica mode.

ORDINAL NUMBERS AND VIEW HT CODE	CODE DESCRIPTION	HIGHLIGHT ON BASIC / HEXADECIMAL	HIGHLIGHT OFF BASIC / HEXADECIMAL
0 (on) 8 (off) HT 1 128	Underline	VDU27,ASC("-"),1 1B,2D,1	VDU27,ASC("-"),0 1B,2D,0
1 (on) 9 (off) HT 1 129	Italics	VDU27,ASC("4") 1B,34	VDU27,ASC("5") 1B,35
2 (on) 10 (off) HT 1 130	Bold (double strike)	VDU27,ASC("G") 1B,47	VDU27,ASC("H") 1B,48
3 (on) 11 (off) HT 1 131	Enlarged	VDU27,ASC("W"),1 1B,57,1	VDU27,ASC("W"),0 1B,57,0
4 (on) 12 (off) HT 1 132	Proportional	VDU27,ASC("p"),1 1B,70,1	VDU27,ASC("p"),0 1B,70,0
5 (on) 13 (off) HT 1 133	Condensed	VDU15 0F	VDU18 12
6 (on) 14 (off) HT 1 134	Superscript	VDU27,ASC("j"),12,27,ASC("S"),0 1B,6A,0C,1B,53,0	VDU27,ASC("J"),12,27,ASC("T") 1B,4A,0C,1B,54
7 (on) 15 (off) HT 1 135	Subscript	VDU27,ASC("J"),9,27,ASC("S"),1 1B,4A,9,1B,53,1	VDU27,ASC("j"),9,27,ASC("T") 1B,6A,9,1B,54
16 (17th set of codes)	Printer reset and pica select	VDU27,ASC("@"),27,ASC("P") 1B,40,1B,50	
\	Backspace	VDU8 8	
£	Deselect end of paper cut off	VDU27,ASC("8") 1B,38	

Table 1. Printer control codes and descriptions for Pica FX-80 driver.

command via the codes 128 to 135 inclusive, while the \ character is interpreted by the driver as a backspace and the screen £ symbol is used to switch off the out-of-paper alarm.

Ambitious

Even with a limited range of options, it is still an ambitious task to produce a driver that will deal with all of them and yet occupy only one page of memory. The challenge was further enlivened for me by courtesy of Acornsoft, which allows View to overwrite location &4FF where I had the misfortune to have placed a flag. Compounding these difficulties was the frustration of knowing that the Basic 1 assembler would not operate from &4FF as the start address.

The printer drivers store 17 sets of printer control codes in a bank of consecutive addresses that are located just after the end of the control program. The codes are divided into two groups, the first eight being responsible for switching on highlights while the next eight switch them off. Every On/Off set of control codes are eight sets apart from one another. Each set of control codes is terminated by a flag, &FF. The control codes are preceded by 17 bytes, one for each control code, which contains the offset. The offset is the number which when added to the base address yields the beginning of the appropriate set of control codes.

Shortage of memory now becomes an acute problem since 77 bytes are required for the printer control codes, 17 bytes for the offsets and at least 12 bytes are requisitioned by View as a jump table to access the printer driver. These together with &4FF are unavailable to the control program. However, the organisation of the codes in the manner described means that 6502 logical operators can be used to allow compact coding.

Listing 1 shows part of the Pica driver assembled at &3400 and includes the printer control codes and offset bytes inserted by indirection operators. The assembled program is saved to disc with a Reload address of &0400. All occurrences of &34 as a MSB in two bytes or non-zero page addresses are converted to &04 by overwriting with a disc utility. The missing assembler mnemonics are contained in listing 2, which represents the assembled control program.

Control program

The program is entered via a jump table, the details of which you can glean from pages 74 and 75 of the View introduction booklet. As the computation for proportional spacing is done by the FX-80 the last two of the jumps are directed to return to View immediately. The printer is turned on by the 6502 equivalent of *FX3,10, namely an Osbyte call, which

(continued on next page)

View printer driver

(continued from previous page)

directs the character output stream to the printer only. This rules out the driver's use with OS 0.1, but it serves to conserve memory.

A string of four bytes — the 17th group of bytes in table 1 — are then output to the printer. This causes printer initialisation by returning all settings to the default condition and then selects Pica mode. Also, location &4FC is set to zero by this routine. Each of the bits at this location will act as a flag for one of the eight switchable highlights. The equivalent of *FX3,0 is used to turn off the printer and re-enable the screen.

Listing 3 contains the data section of the Basic 1 assembler for the elite driver. This material is directly superimposable over the Pica data. There is no need to alter any of the source code in order to assemble the Elite driver.

The characters output from View during printing contain a mixture of some which are printable; those which are highlight codes, &80 to &87; some which could be erroneous highlight codes, greater than &87; plus two codes which are represented by \ which is used to force a backspace and £, which is used to turn off the paper-out alarm and cut off. They are passed to the printer driver via the accumulator.

Sorting codes

The first task is to sort the incoming characters, after saving all 6502 registers. A loop is entered after first loading the X register with the number corresponding to the highest numbered highlight to be allowed from within View. The X register is then decremented until it falls below &80. The sign flag treats the number in the X register as a signed integer; numbers greater than &80 are treated as being negative. The loop is forced by BMI.

Highlights are detected by comparing the X register with the contents of the stored accumulator. A branch occurs if the comparison succeeds, leaving the highlight character in the X register. If the accumulator contains a number greater than &87, it is detected by the BCC instruction which relates to CPX, which sets the carry flag, and not to DEX, which doesn't. All other characters are passed to the character output routine.

The highlight number is then converted to an ordinal number from 0 to 7 which corresponds to the appropriate set of printer codes. This is achieved by switching

```
   >.....*.......*.......*.......*.......*.......*.......*.......*.<
CE PICA HIGHLIGHTS
   £  - forces end-of-paper alarm and cutoff deselect


LM 10
   NO  HIGHLIGHT
   no highlight


   _HIGHLIGHT 1 128_                    UNDERLINE
   _highlight 1 128_


   *HIGHLIGHT 2 129*                    ITALICS
   *highlight 2 129*


HT 1 130
HT 2 131
   _HIGHLIGHT 1 130_                    DOUBLE STRIKE
   _highlight 1 130_


   *HIGHLIGHT 2 131*                    ENLARGED
   *highlight 2 131*


HT 1 132
HT 2 133

   _HIGHLIGHT 1 132_                    PROPORTIONAL MODE / BOLD
   _highlight 1 132_


   *HIGHLIGHT 2 133*                    CONDENSED
   *highlight 2 133*


HT 1 134
HT 2 135
   _HIGHLIGHT 1 134_                    TRUE SUPERSCRIPT
   _highlight 1 134_

   *HIGHLIGHT 2 135*                    TRUE SUBSCRIPT
   *highlight 2 135*


   CE 5Fe_2+_\\*(AQ)**MnO_-_\*4(AQ)**8H_+_\*(AQ)*--->5Fe_3+_\\*(AQ)**Mn_2+_\\*(AQ)**4H*2*O


   Note:  Both condensed and enlarged printing upset the letter spacing!
```

Figure 2. Screen reconstruction of source file for highlight demonstration.

Listing 2.

```
0400            OPT PASS%
0400            .jump_table
0400 4C 0D 04   JMP char_out
0403 4C 7A 04   JMP printer_on
0406 4C 96 04   JMP printer_off
0409 4C 79 04   JMP exit \                  prop. spacing handled by printer
040C 60         RTS
040D            .char_out
040D 8D FC 04   STA accumulator_store \ save all registers
0410 98         TYA
0411 48         PHA
0412 8A         TXA
0413 48         PHA
0414 A2 87      LDX £last_highlight
0416            .find_highlight
0416 EC FC 04   CPX accumulator_store
0419 F0 21      BEQ store_highlight \   found a highlight
041B CA         DEX
041C 30 F8      BMI find_highlight
041E 90 59      BCC exit  \             reject HT's that are too large
0420            .not_highlight
0420 AD FC 04   LDA accumulator_store
0423 C9 5C      CMP £92 \               catch backslash to use as backspace
0425 F0 07      BEQ pivot_1
0427 C9 60      CMP £96 \               "£" used to force alarm deselect
0429 F0 08      BEQ pivot_2
042B 4C 6F 04   JMP print_char
042E            .pivot_1
042E A9 08      LDA £8 \                force backspace
0430 4C 6F 04   JMP print_char
0433            .pivot_2
0433 A9 1B      LDA £27 \               deselect paper alarm and cut off
0435 20 EE FF   JSR OSWRCH
0438 A9 38      LDA £ASC("8")
043A D0 33      BNE print_char
043C            .store_highlight
```

NO HIGHLIGHT
no highlight

HIGHLIGHT 1 128
highlight 1 128
Underline

HIGHLIGHT 2 129
highlight 2 129
Italic

HIGHLIGHT 1 130
highlight 1 130
Double strike

HIGHLIGHT 2
highlight 2
Enlarged

HIGHLIGHT 1 132
highlight 1 132
Proportional mode

HIGHLIGHT 2 133
highlight 2 133
Condensed

HIGHLIGHT 1 134
highlight 1 134
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HIGHLIGHT 2 135
highlight 2 135
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4 (on) 12 (off) HT 1 132	Proportional	VDU27,ASC("p"),1 1B,70,1	VDU27,ASC("p"),0 1B,70,0
5 (on) 13 (off) HT 1 133	Condensed	VDU15 0F	VDU18 12
6 (on) 14 (off) HT 1 134	Superscript	VDU27,ASC("j"),12,27,ASC("S"),0 1B,6A,0C,1B,53,0	VDU27,ASC("J"),12,27,ASC("T") 1B,4A,0C,1B,54
7 (on) 15 (off) HT 1 135	Subscript	VDU27,ASC("J"),9,27,ASC("S"),1 1B,4A,9,1B,53,1	VDU27,ASC("j"),9,27,ASC("T") 1B,6A,9,1B,54
16 (17th set of codes)	Printer reset and pica select	VDU27,ASC("@"),27,ASC("P") 1B,40,1B,50	
\	Backspace	VDU8 8	
£	Deselect end of paper cut off	VDU27,ASC("8") 1B,38	

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Ambitious

Even with a limited range of options, it is still an ambitious task to produce a driver that will deal with all of them and yet occupy only one page of memory. The challenge was further enlivened for me by courtesy of Acornsoft, which allows View to overwrite location &4FF where I had the misfortune to have placed a flag. Compounding these difficulties was the frustration of knowing that the Basic 1 assembler would not operate from &4FF as the start address.

The printer drivers store 17 sets of printer control codes in a bank of consecutive addresses that are located just after the end of the control program. The codes are divided into two groups, the first eight being responsible for switching on highlights while the next eight switch them off. Every On/Off set of control codes are eight sets apart from one another. Each set of control codes is terminated by a flag, &FF. The control codes are preceded by 17 bytes, one for each control code, which contains the offset. The offset is the number which when added to the base address yields the beginning of the appropriate set of control codes.

Shortage of memory now becomes an acute problem since 77 bytes are required for the printer control codes, 17 bytes for the offsets and at least 12 bytes are requisitioned by View as a jump table to access the printer driver. These together with &4FF are unavailable to the control program. However, the organisation of the codes in the manner described means that 6502 logical operators can be used to allow compact coding.

Listing 1 shows part of the Pica driver assembled at &3400 and includes the printer control codes and offset bytes inserted by indirection operators. The assembled program is saved to disc with a Reload address of &0400. All occurrences of &34 as a MSB in two bytes or non-zero page addresses are converted to &04 by overwriting with a disc utility. The missing assembler mnemonics are contained in listing 2, which represents the assembled control program.

Control program

The program is entered via a jump table, the details of which you can glean from pages 74 and 75 of the View introduction booklet. As the computation for proportional spacing is done by the FX-80 the last two of the jumps are directed to return to View immediately. The printer is turned on by the 6502 equivalent of *FX3,10, namely an Osbyte call, which

(continued on next page)

View printer driver

(continued from previous page)

directs the character output stream to the printer only. This rules out the driver's use with OS 0.1, but it serves to conserve memory.

A string of four bytes — the 17th group of bytes in table 1 — are then output to the printer. This causes printer initialisation by returning all settings to the default condition and then selects Pica mode. Also, location &4FC is set to zero by this routine. Each of the bits at this location will act as a flag for one of the eight switchable highlights. The equivalent of *FX3,0 is used to turn off the printer and re-enable the screen.

Listing 3 contains the data section of the Basic 1 assembler for the elite driver. This material is directly superimposable over the Pica data. There is no need to alter any of the source code in order to assemble the Elite driver.

The characters output from View during printing contain a mixture of some which are printable; those which are highlight codes, &80 to &87; some which could be erroneous highlight codes, greater than &87; plus two codes which are represented by \ which is used to force a backspace and £, which is used to turn off the paper-out alarm and cut off. They are passed to the printer driver via the accumulator.

Sorting codes

The first task is to sort the incoming characters, after saving all 6502 registers. A loop is entered after first loading the X register with the number corresponding to the highest numbered highlight to be allowed from within View. The X register is then decremented until it falls below &80. The sign flag treats the number in the X register as a signed integer; numbers greater than &80 are treated as being negative. The loop is forced by BMI.

Highlights are detected by comparing the X register with the contents of the stored accumulator. A branch occurs if the comparison succeeds, leaving the highlight character in the X register. If the accumulator contains a number greater than &87, it is detected by the BCC instruction which relates to CPX, which sets the carry flag, and not to DEX, which doesn't. All other characters are passed to the character output routine.

The highlight number is then converted to an ordinal number from 0 to 7 which corresponds to the appropriate set of printer codes. This is achieved by switching

```
   >.....*.....*.....*.....*.....*.....*.....*.....*.....*.<
CE PICA HIGHLIGHTS
   £  - forces end-of-paper alarm and cutoff deselect


LM 10
   NO  HIGHLIGHT
   no highlight


   _HIGHLIGHT 1 128_                    UNDERLINE
   _highlight 1 128_


   *HIGHLIGHT 2 129*                    ITALICS
   *highlight 2 129*


HT 1 130
HT 2 131
   _HIGHLIGHT 1 130_                    DOUBLE STRIKE
   _highlight 1 130_


   *HIGHLIGHT 2 131*                    ENLARGED
   *highlight 2 131*


HT 1 132
HT 2 133

   _HIGHLIGHT 1 132_                    PROPORTIONAL MODE / BOLD
   _highlight 1 132_


   *HIGHLIGHT 2 133*                    CONDENSED
   *highlight 2 133*


HT 1 134
HT 2 135
   _HIGHLIGHT 1 134_                    TRUE SUPERSCRIPT
   _highlight 1 134_

   *HIGHLIGHT 2 135*                    TRUE SUBSCRIPT
   *highlight 2 135*


   CE 5Fe_2+_\\*(AQ)**MnO_-_\*4(AQ)**8H_+_\*(AQ)*--->5Fe_3+_\\*(AQ)**Mn_2+_\\*(AQ)**4H*2*O


   Note:  Both condensed and enlarged printing upset the letter spacing!
```

Figure 2. Screen reconstruction of source file for highlight demonstration.

Listing 2.

```
0400           OPT PASS%
0400           .jump_table
0400 4C 0D 04  JMP char_out
0403 4C 7A 04  JMP printer_on
0406 4C 96 04  JMP printer_off
0409 4C 79 04  JMP exit \                prop. spacing handled by printer
040C 60        RTS
040D           .char_out
040D 8D FC 04  STA accumulator_store \ save all registers
0410 98        TYA
0411 48        PHA
0412 8A        TXA
0413 48        PHA
0414 A2 87     LDX £last_highlight
0416           .find_highlight
0416 EC FC 04  CPX accumulator_store
0419 F0 21     BEQ store_highlight \    found a highlight
041B CA        DEX
041C 30 F8     BMI find_highlight
041E 90 59     BCC exit  \               reject HT's that are too large
0420           .not_highlight
0420 AD FC 04  LDA accumulator_store
0423 C9 5C     CMP £92 \                 catch backslash to use as backspace
0425 F0 07     BEQ pivot_1
0427 C9 60     CMP £96 \                 "£" used to force alarm deselect
0429 F0 08     BEQ pivot_2
042B 4C 6F 04  JMP print_char
042E           .pivot_1
042E A9 08     LDA £8 \                  force backspace
0430 4C 6F 04  JMP print_char
0433           .pivot_2
0433 A9 1B     LDA £27 \                 deselect paper alarm and cut off
0435 20 EE FF  JSR OSWRCH
0438 A9 38     LDA £ASC("8")
043A D0 33     BNE print_char
043C           .store_highlight
```

```
043C 8A          TXA
043D 49 80       EOR £&80 \              switch off bit 7 (subtract 128)
043F AA          TAX
0440 8D FE 04 STA control \              remember highlight ordinal number
0443 A0 00       LDY £0
0445 98          TYA
0446 38          SEC
0447             .find_flag \            place "1" in the relevant bit pos.
0447 2A          ROL A
0448 CA          DEX
0449 10 FC       BPL find_flag
044B             .test_flag
044B 2C FD 04 BIT flags \                is flag set?
044E F0 02       BEQ switch_flags
0450             .flags_1
0450 A0 08       LDY £8 \                init. Y-register; selects "off" HT's
0452             .switch_flags
0452 4D FD 04 EOR flags
0455 8D FD 04 STA flags
0458             .offset_1
0458 98          TYA
0459 0D FE 04 ORA control
045C A8          TAY
045D             .offset_2
045D B9 9E 04 LDA offset,Y \             get offset for printer codes
0460 A8          TAY
0461             .print_control_chars
0461 B9 AF 04 LDA data,Y
0464 C9 FF       CMP £&FF
0466 F0 0A       BEQ recall
0468 20 EE FF JSR OSWRCH
046B C8          INY
046C 4C 61 04 JMP print_control_chars
046F             .print_char
046F 20 EE FF JSR OSWRCH
0472             .recall
0472 68          PLA
0473 AA          TAX
0474 68          PLA
0475 A8          TAY
0476 AD FC 04 LDA accumulator_store
0479             .exit
0479 60          RTS
047A             .printer_on \           OS > 1.0 only
047A A9 00       LDA £0
047C 8D FD 04 STA flags
047F A9 03       LDA £3
0481 A2 0A       LDX £10
0483 20 F4 FF JSR OSBYTE
0486             .pica
0486 A0 47       LDY £&47
0488             .set_printer
0488 B9 AF 04 LDA data,Y
048B C9 FF       CMP £&FF
048D F0 EA       BEQ exit
048F 20 EE FF JSR OSWRCH
0492 C8          INY
0493 4C 88 04 JMP set_printer
0496             .printer_off
0496 A9 03       LDA £3
0498 A2 00       LDX £0
049A 20 F4 FF JSR OSBYTE
049D 60          RTS
049E             .offset
04AF             OPT PASS%
04AF             .data
```

Listing 3.

```
1140 !offset=&0A070400
1150 !(offset+4)=&1E17150E
1160 !(offset+8)=&2F2D2925
1170 !(offset+12)=&413B3933
1180 ?(offset+16)=&47
1190 !data=&FF012D1B
1200 !(data+4)=&1BFF341B
1210 !(data+8)=&571BFF47
1220 !(data+12)=&531BFF01
1230 !(data+16)=&094A1B00
1240 !(data+20)=&1BFF0BFF
1250 !(data+24)=&531B0C6A
1260 !(data+28)=&4A1BFF00
1270 !(data+32)=&01531B09
1280 !(data+36)=&002D1BFF
1290 !(data+40)=&FF351BFF
1300 !(data+44)=&1BFF481B
1310 !(data+48)=&1BFF0057
1320 !(data+52)=&096A1B54
1330 !(data+56)=&1BFF0BFF
1340 !(data+60)=&541B0C4A
1350 !(data+64)=&096A1BFF
1360 !(data+68)=&1BFF541B
1370 !(data+72)=&FF4D1B40
```

off bit 7 by an EOr with &80 and is equivalent to the subtraction of decimal 128. At this point, the ordinal number is stored while the X register retains the same value. Zero is now placed in the accumulator and the carry flag is set. The ensuing loop rotates the carry bit through the accumulator until it is placed in the bit position corresponding to the highlight flag. The BIT operation now ascertains whether the flag has been set.

If the test does not succeed, the ordinal number is not changed and the highlight is Off. However, a successful result causes 8 to be added to the ordinal number. The related On/Off printer codes are eight sets apart by an ORA command after the appropriate bit of flags has been switched by EOr. The offset value is now obtained from a knowledge of the ordinal number, and the printer control codes are finally accessed by indexing the incrementing offset value against the base address data.

Output

The remainder of the character stream is checked for the presence of \ and £. If they are found then action is taken; if not the character is output for printing.

Once the printer driver is installed key in

printer pica <return>

as described in the View handbooks. A screen reconstruction — see figure 2 — shows how the various highlights and special effects can be obtained. Use of the backslash brings the subscripting and superscripting beneath each other in the chemical equation. The self-cancelling of FX-80 highlight functions occurs only for those varieties that affect the column spacing. Figure 1 shows how this feature can be combined with isolated highlight codes within View in order to obtain mixed effects.

Warning

Finally, a word of warning. View reinitialises the printer for every sheet. If the £ symbol has been used to deselect the paper-out function, then it must be placed somewhere before the end of each page. This is tedious because, for all of its many good qualities, View does not allow the paging of documents.

There is no easy way out of this problem, except by not initialising the printer at the start of the printing. It seemed to me to be an example of Hobson's choice and so I myself chose the cleaner initialisation. Acorn is busy developing further drivers for the new generation of printers but until they appear the two drivers described can provide the text highlights that most users require.

Copies of the two printer drivers, plus two example View files displaying the highlights described in this article, together with screen pattern dumps from the BBC can be obtained on a cassette from the author at 34 Cross Way, Harpenden, Hertfordshire AL5 4QU for £6.50.

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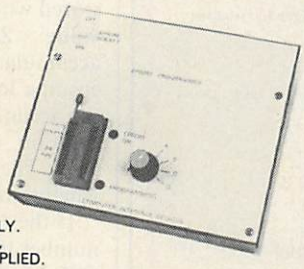

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A universal monitor

Some more ideas from Peter and Owen Benson on interfacing an Apple with the real world.

THE ARTICLE entitled Apple operations — *Practical Computing*, February issue — discussed methods for using the game-paddle inputs or ports of the Apple II for interfacing with the real world. Since the Apple game paddles are just variable resistors, you can hook up any device which responds to changing environments by altering its resistance, such as a thermistor, a light-dependent resistor or a carbon microphone. Without any need for an external analogue to digital converter, you can measure changes in events and plot these values on graphs or use them to control electrical devices. The Apple measures any resistance between 0Ω and 150kΩ and converts it to a number between 0 and 255, which is accessed from a Basic program by using instructions such as

```
PRINT PDL (0)
```

or

```
IF PDL(1)>150 THEN ...
```

Using a thermistor as the sensing device, you can get the Apple to measure temperatures rapidly and record their values, over very long periods if necessary, for later graphing. However, many of the needs for temperature information can be satisfied with only the maximum and minimum values, or those which remain constant for more than a specified length of time, or all the values which exceed a set limit.

In such cases, a regular maximum and minimum thermometer would not provide the desired information, yet the computer can easily be programmed to sift and save the needed data. Listing 1 shows a program to take temperature readings at approximately 1 minute intervals. All values that exceed 200 are stored together with the time when they were taken. The value 200 would correspond to the resistance of the thermistor at a specific temperature.

You can make a device to measure and display your pulse rate based on the light-dependent resistor. You shine a small torch bulb through the tip of your finger, and the amount of light striking an LDR on the other side of your finger will depend on the amount of blood in it.

Use a type 222 torch bulb stuck into a hole in the side of a plastic 35mm. film canister, so that just the lens portion is inside the canister. Attach the LDR to the opposite side of the canister, covering a small hole. Hold the LDR in place with black plastic tape to exclude any stray light.

When your forefinger is inserted into the canister, it blocks the light from the bulb shining on to the LDR — see figure 1. The computer monitors the resistance of the LDR and plots a bar graph showing how the resistance — in this case the blood flow — varies with time. Using such a device you

(continued on next page)

Listing 1.

```
10 DIM R(1ØØØ,2) : N = Ø : T = Ø
20 FOR T1 = Ø TO 45225 : NEXT T1
30 T = T + 1
40 P = PDL(Ø)
50 IF P > 2ØØ THEN N = N+1 : R(N,1) = P : R(N,2) = T
60 GOTO 2Ø
```

Listing 2.

```
10  REM:  TAKE 4Ø READINGS
20  MN = 256 : MX = -1 : DIM Y(4Ø)
30  HOME
40  FOR X = 1 TO 39 : Y(X) = PDL(Ø) : NEXT X
50  FOR X = 1 TO 39
60  IF Y(X) < MN THEN MN = Y(X)
70  IF Y(X) > MX THEN MX = Y(X)
80  NEXT X
90  IF MN = MX THEN 4Ø
100 YM = 22/(MX - MN)
110 FOR X = 1 TO 39
120 K = INT((Y(X) - MN)*YM) + 1
130 FOR Y = K TO 23
140 HTAB X : VTAB Y
150 PRINT "+"
160 NEXT Y
170 NEXT X
180 VTAB 24 : GET U$
```

Listing 3.

```
10  HGR2 : HCOLOR=3
20  FOR X = Ø TO 279
30  P = PDL(Ø)
40  IF P> 191 THEN P = 191
50  HPLOT X, P
60  NEXT X
70  END
```

Listing 4.

```
10 HGR2
20 DIM A(28Ø)
30 FOR X = Ø TO 279
40 P = PDL(Ø)
50 IF P>191 THEN P = 191
60 HCOLOR = Ø:HPLOT X, A(X)
70 HCOLOR = 3:HPLOT X, P
80 A(X) = P
90 NEXT X
100 GOTO 3Ø
```

Listing 5.

```
10  HOME : HGR2 : HGR : POKE 49234,0
20  PRINT  CHR$ (4);"BLOAD P5.OBJ"
30  CALL 24576

SOURCE FILE: OSCS.0

0000:              1 ********************
0000:              2 * MACHINE-CODE      *
0000:              3 * OSCILLOSCOPE      *
0000:              4 * -USES LOOK-UP     *
0000:              5 * TABLES.....      *
0000:              6 ********************
----- NEXT OBJECT FILE NAME IS OSCILLOSCOPE
6390:              7          ORG  $6390
00E0:              8 SCRNL    EQU  $E0
00E1:              9 SCRNH    EQU  $E1
00E2:             10 PRVYL    EQU  $E2
00E3:             11 PRVYH    EQU  $E3
0036:             12 TMPA     EQU  $36
0037:             13 TMPX     EQU  $37
0038:             14 TMPY     EQU  $38
4000:             15 YSTOR    EQU  $4000
C064:             16 PDL      EQU  $C064
C070:             17 PTRIG    EQU  $C070
6003:             18 HRTH     EQU  $6003
60C3:             19 HRTL     EQU  $60C3
6183:             20 XBIT     EQU  $6183
6286:             21 XBYT     EQU  $6286
6390:AD 50 C0     22          LDA  $C050
6393:AD 57 C0     23          LDA  $C057
6396:AD 54 C0     24          LDA  $C054
6399:AD 52 C0     25          LDA  $C052
639C:AD 70 C0     26 FAST     LDA  PTRIG
639F:A0 00        27          LDY  #$00
63A1:AD 64 C0     28 FPLP     LDA  PDL
63A4:10 04        29          BPL  UP
63A6:C8           30          INY
63A7:D0 FB        31          BNE  FPLP
63A9:88           32          DEY
63AA:C0 BF        33 UP       CPY  #$BF
63AC:90 02        34          BCC  OK
63AE:A0 BF        35          LDY  #$BF
63B0:84 38        36 OK       STY  TMPY
63B2:BD 83 61     37          LDA  XBIT,X
63B5:85 36        38          STA  TMPA
63B7:BD 86 62     39          LDA  XBYT,X
63BA:85 37        40          STA  TMPX
63BC:BC 00 40     41          LDY  YSTOR,X
63BF:B9 03 60     42          LDA  HRTH,Y
63C2:85 E3        43          STA  PRVYH
63C4:B9 C3 60     44          LDA  HRTL,Y
63C7:18           45          CLC
63C8:65 37        46          ADC  TMPX
63CA:85 E2        47          STA  PRVYL
63CC:A5 36        48          LDA  TMPA
63CE:A0 00        49          LDY  #$00
63D0:51 E2        50          EOR  (PRVYL),Y
63D2:91 E2        51          STA  (PRVYL),Y
63D4:A4 38        52          LDY  TMPY
63D6:98           53          TYA
63D7:9D 00 40     54          STA  YSTOR,X
63DA:B9 03 60     55          LDA  HRTH,Y
63DD:85 E1        56          STA  SCRNH
63DF:B9 C3 60     57          LDA  HRTL,Y
63E2:18           58          CLC
63E3:65 37        59          ADC  TMPX
63E5:85 E0        60          STA  SCRNL
63E7:A5 36        61          LDA  TMPA
63E9:A0 00        62          LDY  #$00
63EB:51 E0        63          EOR  (SCRNL),Y
63ED:91 E0        64          STA  (SCRNL),Y
63EF:E8           65          INX
63F0:4C 9C 63     66          JMP  FAST
```

(continued from previous page)

can observe the effect of exercise or smoking a cigarette has on your pulse rate — see listing 2.

An oscilloscope is an electronic device for displaying the values of a function which changes with time. A beam of electrons moves steadily across a screen while any changes deflect the beam above and below its usual path, so that a picture of the changes is presented on the screen. The Apple can achieve the same effect, though more slowly, using any changes which can be converted into changes of resistance. Listing 3 shows a program which displays the readings of a thermistor or LDR in the form of an oscilloscope output. The program plots a single sweep of the screen.

If you happen to want to take

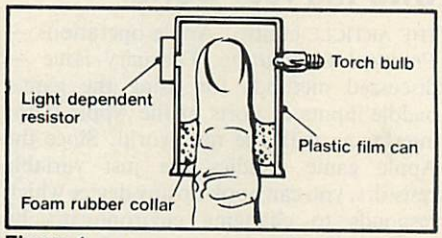

Figure 1.

```
6000- 4C 90 63 20 24 28 2C 30
6008- 34 38 3C 20 24 28 2C 30
6010- 34 38 3C 21 25 29 2D 31
6018- 35 39 3D 21 25 29 2D 31
```

(continued opposite)

Listing 6.

```
10  HOME : VTAB 4:R1 = 16384:R2 = 16394:NUM = 224:FS = 49234:D$ =  CHR$ (4
    )
20  PRINT  TAB( 13)"APPLE.SCOPE": PRINT
30  PRINT  TAB( 6)"COPYRIGHT BY: OWEN BENSON": PRINT
40  PRINT  TAB( 11)"24 DECEMBER 1983": PRINT : PRINT
50  PRINT D$;"BLOAD P6.OBJ"
60  PRINT "PRESS ANY KEY TO CONTINUE:";: GET U$
70  HOME : VTAB 4
80  PRINT "MAX NUMBER OF POINTS FOR-1 SET : 20000": PRINT  TAB( 25)"-2 SET
    S: 10000"
90  PRINT : INPUT "NUMBER OF READINGS TO BE TAKEN:";N
100  REM * SET-UP N FOR M/C *
110 HI =  INT (N / 256) + 64:LO = N -  INT (N / 256) * 256 + 58: IF LO > 2
    55 THEN LO = LO - 255:HI = HI + 1
120  POKE NUM + 1,HI: POKE NUM,LO
130  PRINT : PRINT "PRESS ANY KEY TO START RECORDING:";: GET U$
140  REM * R1=M/C ROUTINE TO READ PADDLE *
150  CALL R1:S = 1
160  PRINT : PRINT N;" READINGS TAKEN": PRINT
170  PRINT "PRESS ANY KEY TO CONTINUE:";: GET U$
180  REM * MAIN MENU *
190  HOME : TEXT : VTAB 4
200  PRINT  TAB( 8)"1) RECORD DATA": PRINT
210  PRINT  TAB( 8)"2) PLOT DATA": PRINT
220  PRINT  TAB( 8)"3) SAVE DATA": PRINT
230  PRINT  TAB( 8)"4) END": PRINT : PRINT
240  PRINT  TAB( 8)"YOUR CHOICE:";: GET U$:U =  VAL (U$): IF U < 1 OR U >
    4 THEN 240
250  HOME : VTAB 4: ON U GOSUB 280,390,770,820
260  GOTO 190
270  REM * RECORD MENU *
280  PRINT  TAB( 8)"1) 1ST SET": PRINT
290  PRINT  TAB( 8)"2) 2ND SET": PRINT : PRINT
300  PRINT  TAB( 8)"YOUR CHOICE:";: GET U$:U =  VAL (U$): IF U = 1 THEN  POP
     : GOTO 70
310  PRINT : IF U <  > 2 THEN 300
320  HOME : VTAB 4: PRINT "PRESS ANY KEY TO START RECORDING:";: GET U$
330  REM * R2=ROUTINE TO RECORD  SECOND SET *
340 HI =  INT (N + 2 / 256) + 64:LO = N + 2 -  INT (N + 2 / 256) * 256 + 5
    9: IF LO > 255 THEN LO = LO - 255:HI = HI + 1
350  POKE NUM + 1,HI: POKE NUM,LO
360  CALL R2:S = 2
370  PRINT : POP : GOTO 160
380  REM * PLOTING ROUTINES *
390  TEXT : VTAB 4
400  PRINT "1ST SET- START:0    END:";N
410  IF S = 1 THEN 430
420  PRINT "2ND SET- START:";N + 1; TAB( 21)"END:";N + 2 + 1
430  INPUT "START,END:";XB,XE
440  PRINT XE - XB;" POINTS   "
450 MX =  - 1:MN = 256
460  FOR X = XB TO XE:Y =  PEEK (16442 + X)
470  IF Y > MX THEN MX = Y
480  IF Y < MN THEN MN = Y
490  NEXT X
500  PRINT "MIN:";MN;" "; TAB( 10)"MAX:";MX
510  INPUT "L)INES OR D)OTS:";L$
520  INPUT "GRID SIZE:";G:G = 0
530  PRINT "PRESS 'G' TO SWITCH GRID ON/OFF"
540  PRINT "PRESS 'N' TO ENTER A DIFFERENT RANGE"
550  PRINT "PRESS 'S' TO RETURN TO MAIN MENU"
560  PRINT "PRESS ANY KEY TO CONTINUE:";: GET U$: PRINT
570  HGR : POKE FS,0: HCOLOR= 3
580 XM = 279 / (XE - XB):YM = 191 / (MX - MN)
590  HPLOT 0,( PEEK (16442 + XB) - MN) * YM
600  FOR X = XB TO XE:Y =  PEEK (16442 + X)
610  IF L$ = "L" THEN 630
620  HPLOT (X - XB) * XM,(Y - MN) * YM: GOTO 640
630  HPLOT  TO (X - XB) * XM,(Y - MN) * YM
640  NEXT X
650  GET U$: IF U$ = "G" THEN  GOSUB 690
660  IF U$ = "N" THEN 390
670  IF U$ = "S" THEN 190
680  GOTO 650
690 U = U + 1: IF U = 2 THEN U = 0
700  HCOLOR= U + 3
710  FOR Y = 0 TO 191 STEP (G / (MX - MN) * 191)
720  HPLOT 0,Y TO 279,Y: NEXT Y
730  FOR X = 0 TO 279 STEP (G / (XE - XB) * 279)
740  HPLOT X,0 TO X,191: NEXT X
750  HCOLOR= 3: RETURN
760  REM * SAVE *
770  INPUT "FILE NAME FOR SAVING:";F$
780  PRINT D$;"OPEN ";F$: PRINT D$;"WRITE ";F$
790  FOR X = 0 TO N: PRINT  PEEK (16442 + X): NEXT X
800  PRINT D$;"CLOSE ";F$: PRINT "SAVED ";N;" READINGS"
810  RETURN
820  HOME : END
```

measurements continuously, then the program has to be made to continue by changing line 70 to read Goto 10. However, this leads to a flickering display which is erased at the end of each sweep, ready for the next one. To correct this you store the location of each dot on the first pass, and plot the same dots in black on the next pass, thus erasing the dots as new ones take their places.

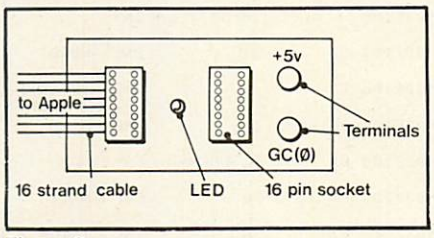

Figure 2.

Inevitably the need comes to take readings more rapidly than can be done in Basic, and for this the program version shown in listing 5 is given in machine code, enabling it to take readings about 10 times faster. You can program the computer to store the data for later use or processing, or to enable you to photograph the waveform.

The program can also be made to run faster. Because it takes time for the computer to display the points on the screen, the process can be speeded up considerably if you only gather the data at first, and display the points afterwards. Listings 6 and 7 show a program which reads and stores up to 20,000 readings — more than 50 complete sweeps of the Hires screen — and then plots any section of these readings as requested. It can also store two distinct sets of readings.

Such display methods involve limitations in terms of absolute accuracy, since the computer takes a longer time to measure a large resistance than a smaller value, so the time interval required for each measurement is not constant, but for most general display purposes this is unimportant.

The easiest of the game inputs to use are the push-buttons PB(0) to PB(2). The push-buttons are normally open, and the program can be set to monitor them to respond when a button is pressed. The instruction takes the form

```
IF PEEK (-16267)>127 THEN...
```

Any kind of switch can be used in place of a push-button.

Rotation Speed

One interfacing technique enables the Apple to measure the speed of rotation of a fan blade. If you attach a magnet to a piece of machinery, and place a magnetic reed-switch nearby, the movement of the magnet past the reed-switch will close the contacts once for each pass. If you connect the switch to the push-button input of the Apple, the computer can either count the impulses, or use them to measure the rotational speed of the machine, as in the program shown in listing 8.

While it is possible to make up a series of individual sensors and plug them in one at a time to the Game I/O socket of the Apple, it is not long before this leads to frustration, if not a few bent pins. So it is advisable to construct a simple connector which can be left permanently plugged into the Game I/O socket, and to which the various sensors can be connected without opening the Apple.

Such a device acts as an extension cord, bringing out as many of the connections as may be needed — very often only two, the +5V line and the GC(0) line which is referred to as PDL(0) in programs. If you need all the connections, the best approach is to buy or make a 16-strand cable with a DIP header plug at the computer end and a socket at the other. It is best to add a small plastic box to the socket end, with two quick-connect terminals. Terminals enable sensors such as thermistors and LDRs to be connected and replaced, without plugging or unplugging any multi-pin DIP connectors.

The LED is driven by the annunciator output and is used to indicate when it has been turned on. If you require game paddles or joysticks they can be plugged into the socket on the connector box.

(continued on next page)

```
6020- 35 39 3D 22 26 2A 2E 32
6028- 36 3A 3E 22 26 2A 2E 32
6030- 36 3A 3E 23 27 2B 2F 33
6038- 37 3B 3F 23 27 2B 2F 33
6040- 37 3B 3F 20 24 28 2C 30
6048- 34 38 3C 20 24 28 2C 30
6050- 34 38 3C 21 25 29 2D 31
6058- 35 39 3D 21 25 29 2D 31
6060- 35 39 3D 22 26 2A 2E 32
6068- 36 3A 3E 22 26 2A 2E 32
6070- 36 3A 3E 23 27 2B 2F 33
6078- 37 3B 3F 23 27 2B 2F 33
6080- 37 3B 3F 20 24 28 2C 30
6088- 34
6000- 4C 90 63 20 24 28 2C 30
6008- 34 38 3C 20 24 28 2C 30
6010- 34 38 3C 21 25 29 2D 31
6018- 35 39 3D 21 25 29 2D 31
6020- 35 39 3D 22 26 2A 2E 32
6028- 36 3A 3E 22 26 2A 2E 32
6030- 36 3A 3E 23 27 2B 2F 33
6038- 37 3B 3F 23 27 2B 2F 33
6040- 37 3B 3F 20 24 28 2C 30
6048- 34 38 3C 20 24 28 2C 30
6050- 34 38 3C 21 25 29 2D 31
6058- 35 39 3D 21 25 29 2D 31
6060- 35 39 3D 22 26 2A 2E 32
6068- 36 3A 3E 22 26 2A 2E 32
6070- 36 3A 3E 23 27 2B 2F 33
6078- 37 3B 3F 23 27 2B 2F 33
6080- 37 3B 3F 20 24 28 2C 30
6088- 34 38 3C 20 24 28 2C 30
6090- 34 38 3C 21 25 29 2D 31
6098- 35 39 3D 21 25 29 2D 31
60A0- 35 39 3D 22 26 2A 2E 32
60A8- 36 3A 3E 22 26 2A 2E 32
60B0- 36 3A 3E 23 27 2B 2F 33
60B8- 37 3B 3F 23 27 2B 2F 33
60C0- 37 3B 3F 00 00 00 00 00
60C8- 00 00 00 80 80 80 80 80
60D0- 80 80 80 00 00 00 00 00
60D8- 00 00 00 80 80 80 80 80
60E0- 80 80 80 00 00 00 00 00
60E8- 00 00 00 80 80 80 80 80
60F0- 80 80 80 00 00 00 00 00
60F8- 00 00 00 80 80 80 80 80
6100- 80 80 80 28 28 28 28 28
6108- 28 28 28 A8 A8 A8 A8 A8
6110- A8 A8 A8 28 28 28 28 28
6118- 28 28 28 A8 A8 A8 A8 A8
6120- A8 A8 A8 28 28 28 28 28
6128- 28 28 28 A8 A8 A8 A8 A8
6130- A8 A8 A8 28 28 28 28 28
6138- 28 28 28 A8 A8 A8 A8 A8
6140- A8 A8 A8 50 50 50 50 50
6148- 50 50 50 D0 D0 D0 D0 D0
6150- D0 D0 D0 50 50 50 50 50
6158- 50 50 50 D0 D0 D0 D0 D0
6160- D0 D0 D0 50 50 50 50 50
6168- 50 50 50 D0 D0 D0 D0 D0
6170- D0 D0 D0 50 50 50 50 50
6178- 50 50 50 D0 D0 D0 D0 D0
6180- D0 D0 D0 01 02 04 08 10
6188- 20 40 01 02 04 08 10 20
6190- 40 01 02 04 08 10 20 40
6198- 01 02 04 08 10 20 40 01
61A0- 02 04 08 10 20 40 01 02
61A8- 04 08 10 20 40 01 02 04
61B0- 08 10 20 40 01 02 04 08
61B8- 10 20 40 01 02 04 08 10
61C0- 20 40 01 02 04 08 10 20
61C8- 40 01 02 04 08 10 20 40
61D0- 01 02 04 08 10 20 40 01
61D8- 02 04 08 10 20 40 01 02
61E0- 04 08 10 20 40 01 02 04
61E8- 08 10 20 40 01 02 04 08
61F0- 10 20 40 01 02 04 08 10
61F8- 20 40 01 02 04 08 10 20
6200- 40 01 02 04 08 10 20 40
6208- 01 02 04 08 10 20 40 01
6210- 02 04 08 10 20 40 01 02
6218- 04 08 10 20 40 01 02 04
6220- 08 10 20 40 01 02 04 08
6228- 10 20 40 01 02 04 08 10
6230- 20 40 01 02 04 08 10 20
6238- 40 01 02 04 08 10 20 40
6240- 01 02 04 08 10 20 40 01
6248- 02 04 08 10 20 40 01 02
6250- 04 08 10 20 40 01 02 04
6258- 08 10 20 40 01 02 04 08
6260- 10 20 40 01 02 04 08 10
6268- 20 40 01 02 04 08 10 20
6270- 40 01 02 04 08 10 20 40
6278- 01 02 04 08 10 20 40 01
6280- 02 04 08 10 20 40 00 00
6288- 00 00 00 00 00 01 01 01
6290- 01 01 01 01 02 02 02 02
6298- 02 02 02 03 03 03 03 03
62A0- 03 03 04 04 04 04 04 04
62A8- 04 05 05 05 05 05 05 05
62B0- 06 06 06 06 06 06 06 07
62B8- 07 07 07 07 07 07 08 08
62C0- 08 08 08 08 08 09 09 09
62C8- 09 09 09 09 0A 0A 0A 0A
62D0- 0A 0A 0A 0B 0B 0B 0B 0B
62D8- 0B 0B 0C 0C 0C 0C 0C 0C
62E0- 0C 0D 0D 0D 0D 0D 0D 0D
62E8- 0E 0E 0E 0E 0E 0E 0E 0F
62F0- 0F 0F 0F 0F 0F 0F 10 10
62F8- 10 10 10 10 10 11 11 11
6300- 11 11 11 11 12 12 12 12
6308- 12 12 12 13 13 13 13 13
6310- 13 13 14 14 14 14 14 14
6318- 14 15 15 15 15 15 15 15
6320- 16 16 16 16 16 16 16 17
6328- 17 17 17 17 17 17 18 18
6330- 18 18 18 18 18 19 19 19
6338- 19 19 19 19 1A 1A 1A 1A
6340- 1A 1A 1A 1B 1B 1B 1B 1B
6348- 1B 1B 1C 1C 1C 1C 1C 1C
6350- 1C 1D 1D 1D 1D 1D 1D 1D
6358- 1E 1E 1E 1E 1E 1E 1E 1F
6360- 1F 1F 1F 1F 1F 1F 20 20
6368- 20 20 20 20 20 21 21 21
6370- 21 21 21 21 22 22 22 22
6378- 22 22 22 23 23 23 23 23
6380- 23 23 24 24 24 24 24 24
6388- 24 25 25 25 25 25 25 25
```

Listing 7.

```
SOURCE FILE: OSCV2.0
------ NEXT OBJECT FILE NAME IS P6.OBJ
4000:            1          ORG  $4000
00E2:            2 YSTOR    EQU  $E2
00E0:            3 NUM      EQU  $E0
FF4A:            4 REGSTOR  EQU  $FF4A
FF3F:            5 REGRES   EQU  $FF3F
C064:            6 PDL      EQU  $C064
C070:            7 PTRIG    EQU  $C070
4000:48          8 R1       PHA
4001:A9 38       9          LDA  #$38
4003:85 E2      10          STA  YSTOR
4005:A9 40      11          LDA  #$40
4007:85 E3      12          STA  YSTOR+1
4009:68         13          PLA
400A:20 4A FF   14 R2       JSR  REGSTOR
400D:A0 00      15          LDY  #$00
400F:A2 00      16 PDRD     LDX  #$00
4011:AD 70 C0   17          LDA  PTRIG
4014:AD 64 C0   18 PDLLP    LDA  PDL
4017:10 04      19          BPL  ENDLP
4019:E8         20          INX
401A:D0 F8      21          BNE  PDLLP
401C:CA         22          DEX
401D:8A         23 ENDLP    TXA
401E:91 E2      24          STA  (YSTOR),Y
4020:A5 E3      25          LDA  YSTOR+1
4022:C5 E1      26          CMP  NUM+1
4024:F0 08      27          BEQ  LOCHK
4026:C8         28 NXTY     INY
4027:D0 E6      29          BNE  PDRD
4029:E6 E3      30          INC  YSTOR+1
402B:4C 0F 40   31          JMP  PDRD
402E:C4 E0      32 LOCHK    CPY  NUM
4030:D0 F4      33          BNE  NXTY
4032:E6 E2      34          INC  YSTOR
4034:20 3F FF   35          JSR  REGRES
4037:60         36          RTS
```

(continued from previous page)

The more you use the Apple for interfacing with the real world, the more it behaves like a universal monitor. It can monitor, measure, store, process and graph any factor which can be converted to a change in resistance, and with light-dependent resistors and thermistors, almost any change can be converted to a change in resistance. The push-button inputs enable you to use switching devices to provide input to the computer. Once the information is in the computer, it can be used to control electrical devices through the annunciator outputs in the same Game I/O socket, using small relays.

Listing 8.

```
10 PB1 = -16287
20 REM:  COUNT NUMBER OF CONTACTS
30 REM:  IN 1Ø SECONDS
40 FOR T = Ø TO 7537
50 IF PEEK (PB1) > 127 THEN N = N + 1
60 NEXT T
70 PRINT "NUMBER OF REVS: "; N
80 PRINT "RPM = "; N*6
90 END
```


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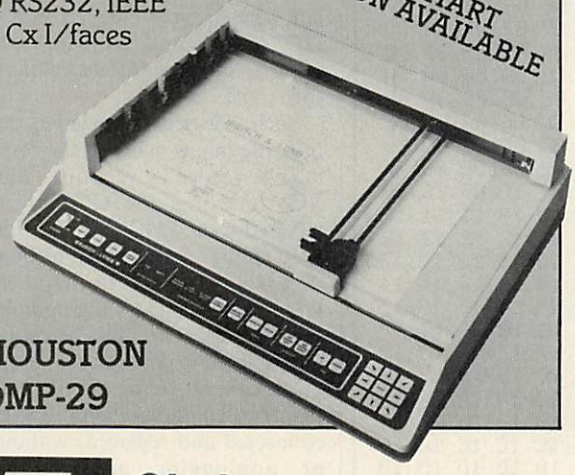

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(continued from page 135)
straining their brains to solve the assorted configurations.

There are several programs which display the cube on the screen and permit moves but this one also solves positions. The display is clear. My own cube has orange where the program shows magenta, but since orange and red could be confused on the screen this is probably just as well.

The program really does solve the cube and eventually recognises any impossible cube configurations you may enter. Sometimes it suggests several moves when one would suffice, but it always gets there in the end. If you have given up hope of ever restoring a muddled cube, this program will do it and provide guidance for future attempts.

Supergolf

You play this singly or between several people, just like the real thing. You have a choice of irons from 1 to 9, plus a wedge and sand iron. They can be used in strengths of 1 to 99. There is also a putter, usable in strengths 1 to 9. The wind provides another variable factor, force 1 to 5.

Each hole has a different terrain, including hills, sand bunkers and sometimes water. You play in two dimensions only: everything is seen in section so you do not need to set direction. The computer keeps a score card for each player and gives appropriate remarks of congratulation after each good shot.

This game is the only good golf simulation I have seen for the BBC. Experienced golf players approve of it, though the consensus is that it allows rather too many holes in one. This is balanced by the difficulty in getting out of bunkers if the first stroke with the sand iron fails, so the par values are about right.

Pirate

Described as an adventure for young people this is good wholesome fun in the Treasure Island tradition. It is full of messages like "Well done Captain. We beat the scurvy dogs!" and it has graphics throughout. The economical mode 7 is used, so the pictures look as if they have been assembled from building blocks. They are still good enough for the purpose.

The real stroke of genius in Pirate is the writer's realisation that cassettes have two sides. The first side gives the initial part of the game where you sail the seas gathering treasure, jewels, flags and magic objects. Keep a map — it is a square world. There are graphics for ships, sea, rocks, four islands and various things like a dragon and a magic cat. This part of the game can be saved.

When enough treasure has been acquired the password is given and you can load the second part, with new graphics for an island-based setting and some new dangers. There is a single-key entry for commands and the whole game is made easy for those not yet familiar with computers. Mode 7 makes the response a little slow, but this did not seem to worry players. Parents could happily leave their offspring to play for hours, and I suspect they would also enjoy playing themselves.

The program is coded in Basic, so alterations or additions can be made easily. For example, in part 1 a line could be added so that when a second pirate ship is captured the mate announces "The Captain says 'Splice the mainbrace, m' hearties' " and everything stops for a while. In part 2, if they get tired of being killed, the program is easily altered. The method used is of the form

```
A = RND(10):IF A > 8 THEN (something
  horrible happens)
```

Just alter the 8 to 10 and none of the interlocking procedures are affected. Line 1480 is the crocodile, 1430 lightning, 1580 avalanche, and so on. In such ways you can encourage players to go inside the program, and eventually write their own.

Great Britain Ltd

First available on the Spectrum, this unusual game simulates the economy of the U.K. You are the prime minister, and your task is to guide the finances for five years, when there is an election.

There are displays of major indicators such as ratings of inflation, unemployment, foreign exchange and your popularity. Other figures include population, tax, income and shopping basket prices. Social benefits can be allocated — less than £250 million has no effect — and levels have to be adjusted in line with inflation. At the end of the year figures are displayed to show the results.

The time of reckoning finally arrives. You watch the votes coming in after the election. Will you survive to rule again or does the country think a different party or coalition should have a chance?

Like all simulations Great Britain Ltd provides a highly simplified version of real life, but it does follow the main pattern. For example, one winning strategy is to push up taxes in the first year, spend enough to have a social reform recognised, drop taxes before an election and invest something on a popular campaign such as law and order. Does this sound familiar? When politicans from the major parties were invited to compete in a contest, playing this program with a five-year-old girl, they chickened out.

The program is written for issue 1 Basic. If you have Basic 2, move line 9245 to 9219, delete 9245 and inserting a new line

```
12025 @% = &0002010A.
```

The Hobbit

Available first for the Spectrum, this outstanding adventure has been adapted for the BBC Model B. The graphics of the original version have gone, as they would require 19K of extra memory. Whether this is a serious loss is a matter of opinion; many people prefer their own mental images of Tolkien characters to those of Walt Disney or computer programmers.

The text-only game has sufficient attractions because of the unusually versatile programming. The language used is termed "Inglish" and permits complicated commands such as "Take the money and run", "Open all the bottles except the green one", or "Drop the sword and follow Gandalf".

Another difference is that all the characters have independence. If you wait a message appears saying "Time passes", while the others are moving around doing their own thing. There is no unique solution to the game: each time it is played variations can appear. Games can be saved, and I know two players who for some time have been meeting regularly each week to make further progress.

Apart from the unusually good programming, a special aspect is that the game comes with a copy of the book, which provides the best guidance to travelling through the program. The Hobbit is in a class of its own for interaction.

	Type	Distributor	Price	Rating
3-Deep Space	arcade	Postern	£7.95	11/20
Saloon Sally	arcade	Psion	£7.95	15/20
Bridge Master	educational	Jonathan Keynes	£24.95	17/20
Cube Master	special	Acornsoft	£9.99	14/20
Crossword Puzzler	educational	National Extension College	£5	14/20
Supergolf	simulation	Squirrel Software	£7.50	17/20
Pirate	adventure	Chalksoft	£9.25	18/20
Great Britain Ltd	business	S W Hessel	£5.95	16/20
The Hobbit	adventure	Melbourne House	£14.95	18/20

Format: All are on cassette; Bridge Master and The Hobbit include a book in the package.
System: Saloon Sally runs on Models A and B; and all the others run on Model B only; Bridge Master also runs on the Electron.

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NLQ = Near Letter Quality.

It's just one of the many outstanding features which put the OKI Microline 92 matrix printer at the top of the 80 column league. Add to this standard print at 160 cps, high resolution graphics, downline-loadable character sets, subscript, superscript and underline capability, and you will see why the Microline 92 is an unbeatable price/performer.

The Microline 93 offers the same unrivalled specification to users requiring a full 136-column format.

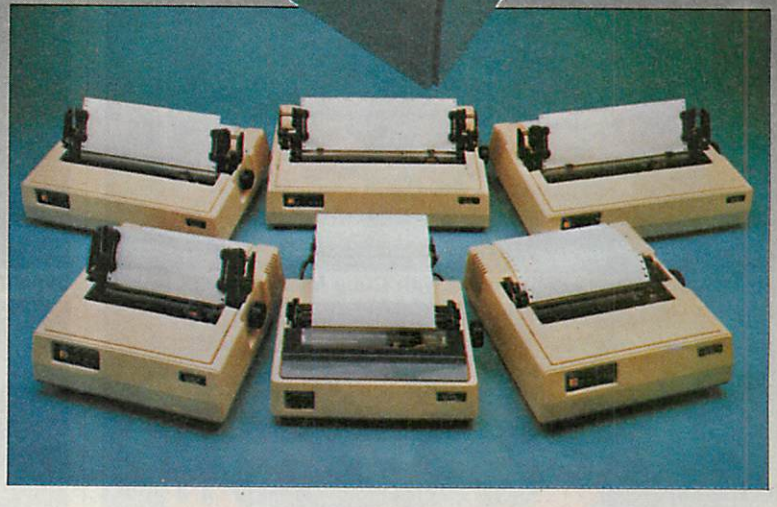
And if all this is not enough, both machines are available with our unique IBM Plug 'n' Play Kit, ensuring full compatibility with the IBM PC.

An even more impressive feature list, including a print speed of 200 cps, defines the 136-column Microline 84. In addition to its increased throughput capability, the optional Automatic Cut Sheet Feeder permits maximum use of the near-letter-quality print mode.

Quality, reliability and unbeatable price/performance are of course hallmarks of the entire OKI Microline range, including the ever popular Microline 80, still a best-selling entry-level printer.

The range is completed by the Microline 82A (80 col) and the Microline 83A (136 col) which offer a print speed of 120 cps amongst a host of other features.

OKI Microlines – the unbeatable printer family!



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a Dyneer company

effect the room should be dark, with no reflections on the screen. Set colour saturation to maximum, and sit about 6ft. from the screen centre. You may find you have to alter the relative colour balance so that no blue is visible through the red filter and vice versa. Some people have difficulty in fusing the images or ignoring the inevitable ghost images, and a few players prefer to remove their spectacles and play without them.

Saloon Sally

The scenario is a fight in Sally's saloon, started by four baddies who brawl around, leaving gold on the tables. Sally tries to pick up the gold while avoiding the villains. If they meet her they throw her on the floor and jump on her until she loses a life.

From time to time the light goes out — symbolised by the screen turning dark blue — and the baddies lose their tempers with the gold-pinching Sally and chase her. She can kick over tables to trap the villains or to disable them for a while.

Points are won for the gold, with a bonus for clearing the tables or for trapping all four men at the same time. On the next level everything happens more quickly and the non-stop music speeds up.

The sound of the honky-tonk piano can become annoying after a while, but can be avoided by a preparatory *FX201, 1, which disables the speaker; *FX201, 0 switches it on again. If you are not using a monitor you will need to move the image down with *TV255, 0.

Bridge Master

Bridge is a complicated game, and learning it can be a painful process. You are likely to be offered conflicting advice from the other players, and have to suffer interminable post-mortems. With this kit the game is learnt to a high standard from an accepted expert, without absorbing any bad habits.

The package consists of two program tapes and two commentaries which you play while working through the games. There is an instruction booklet and also a book by Terence Reece, called *Begin Bridge With Reece*.

The graphics are adequate, though not outstanding. The value of the program lies in its methodical and thorough approach. At the moment it is unique but perhaps similar packages will be devised for other subjects. The program also runs on the Acorn Electron.

Crossword Puzzler

This program does not help you make up crosswords nor solve them, and it is not the equivalent of a crossword dictionary. What it does is assist in the presentation of a crossword of up to 15 columns, 13 rows and 60 clues.

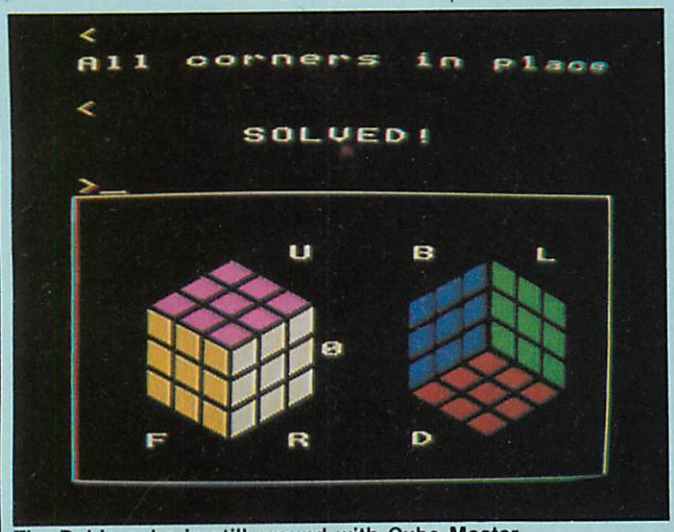
The grid and letters are displayed on the screen together with a requested clue. You then have a choice of entering an answer or of being given it. If you enter the wrong answer it appears in lower case and you can have another try.

The ready-made puzzles included are called Quickpuzz, Firstpuzz, Juniorpuzz and Cen4507. They increase in difficulty in that order. The idea is that you write suitable programs yourself — perhaps to help teach spelling or foreign-language vocabulary.

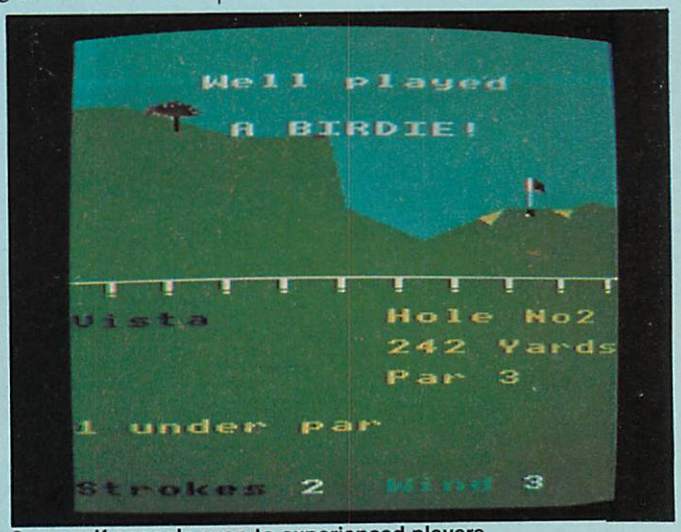
Cube Master

Remember the Rubic cube? After the first fuss has died down there were millions of cubes left behind, with people

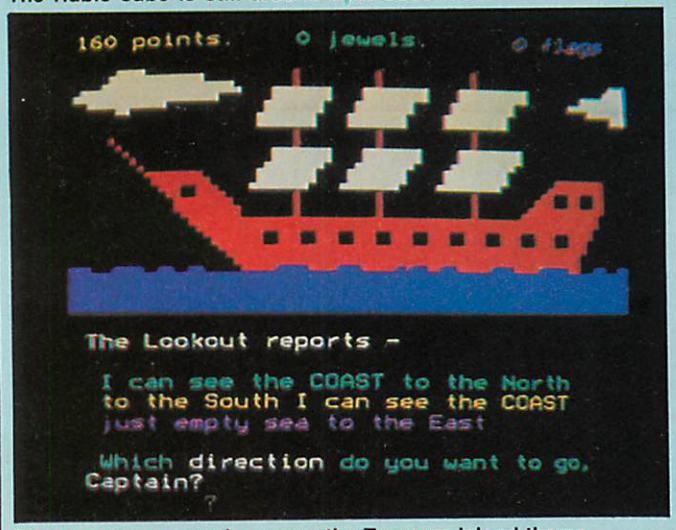
(continued on page 137)



The Rubic cube is still around with Cube Master.



Supergolf appeals even to experienced players.


160 points.
jewels.
The Lookout reports -
I can see the COAST to the North
to the South I can see the COAST
just empty sea to the East
Which direction do you want to go,
Captain?

Pirate — two games in one on the Treasure Island theme.

RT HON NEVILLE MAUDE PM
Term : 2
Year : 1
Inflation : 5%
Unemployment : 0.8M.
Reforms : 0
Exchange Rate : $2.01/£
Pop.Rtng : 68
Acc.Bal :£ 16733M.
REFORM OPPORTUNITIES
A Improve Health Service :£ 600M
B Build New Homes :£ 600M
C Jobs for School Leavers :£ 600M
D Build New Schools :£ 600M
E Improve Road System :£ 600M
F When finished
Enter PREFIX of reform to change

You too can ruin the economy with Great Britain Ltd.

Playing with a point

Neville Maude selects some programs for the BBC Micro which go beyond chasing blobs and zapping aliens.

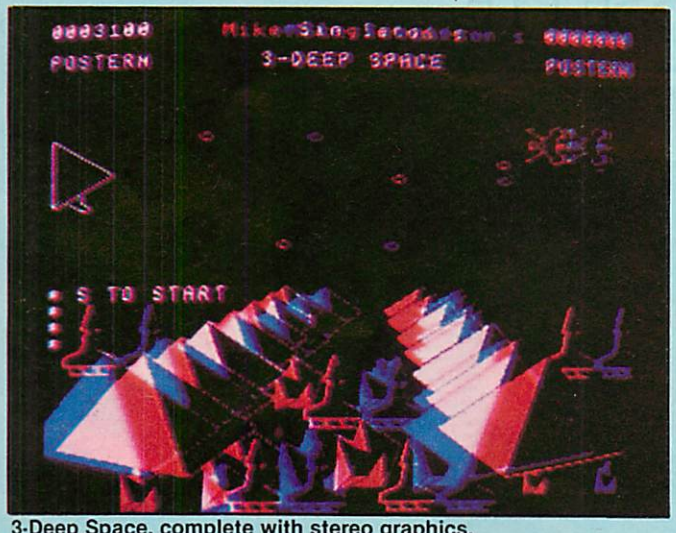
BBC MICRO USERS can choose from countless look-alike games of the Pacman, Invaders and Donkey Kong type. But there are a few which have that extra something which lifts them above the normal run of games.

3-Deep Space

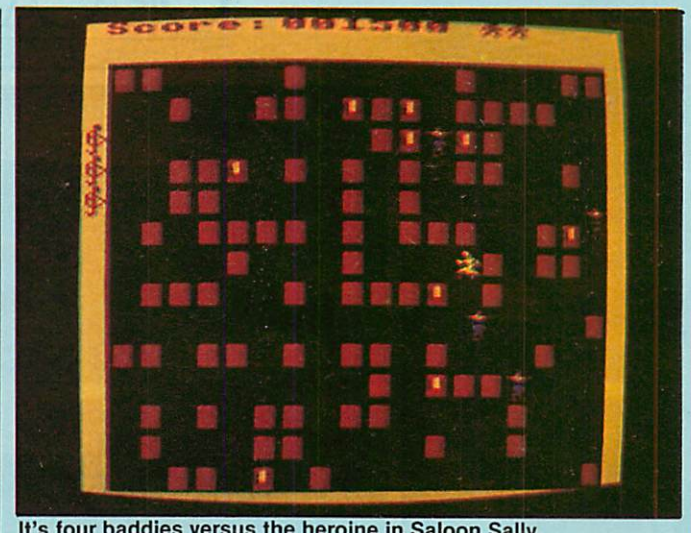
Stereoscopic pictures have passed into and out of fashion through the years. Now it is the turn of computer games to get the stereo treatment. The only method adaptable to TV screens, where polarisation is impossible, is that of anaglyphs: the image is in two colours, each visible to one eye only. Spectacles with coloured foils — usually red and cyan or red and green — are used, and the brain fuses the two images into one to give the illusion of three dimensions.

The game of 3-Deep Space presents a screen display of pyramids with grounded spaceships. You are the captain of spaceship *Interceptor*, and your task is to defend the stargate. Aliens sweep in horizontally from the right and must be shot down by a laser or a smart bomb before they collide with you. Andromedan starcruisers of various classes are worth increasing points as the game progresses. The game is played in three dimensions with controls to move into or out of the screen as well as up or down and right or left.

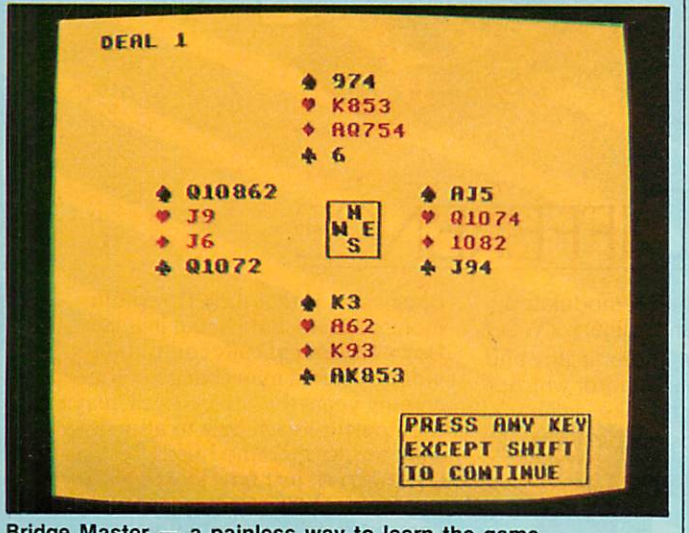
To get the best of the stereoscopic



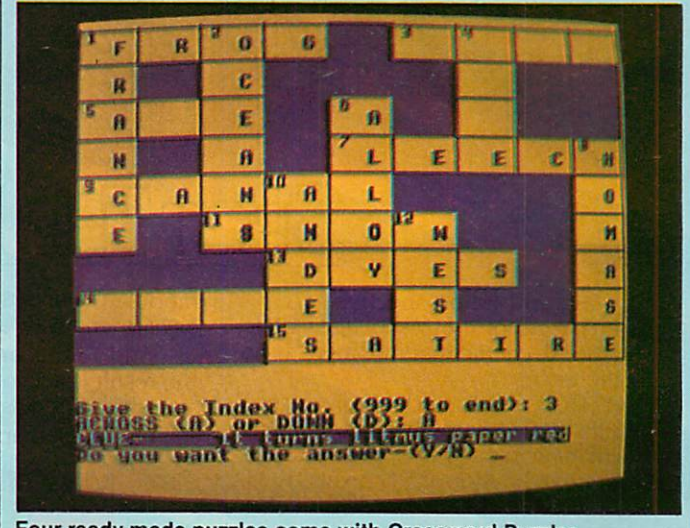
3-Deep Space, complete with stereo graphics.



It's four baddies versus the heroine in Saloon Sally.

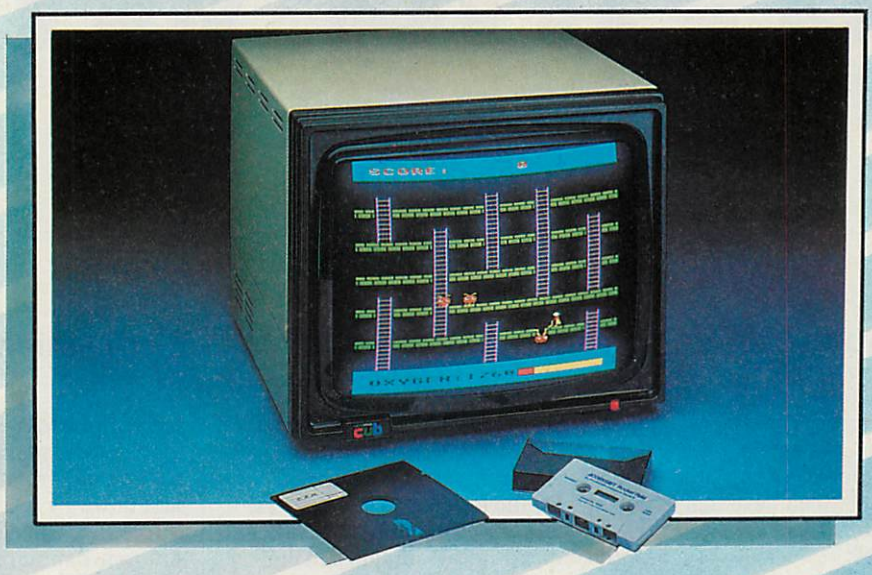


Bridge Master — a painless way to learn the game.



Four ready-made puzzles come with Crossword Puzzler.

BREATHTAKING IMAGES FROM DISC OR CASSETTE



BREATHTAKING IMAGES FROM DISC OR CASSETTE

-SPOT THE DIFFERENCE

Happily for prospective purchasers of the Microvitec CUB RGB/PAL colour monitor there is no difference.

This superb machine produces brilliant pin-sharp images when used with a micro computer, thanks to a screen resolution of 585 pixels by 452, plus a bandwidth in excess of 15MHz. Yet the RGB/PAL also gives the highest quality pictures from laser discs, V.C.R.'s and video cameras. This is because the signal is not modulated and then remodulated, as happens with an ordinary T.V. set.

Add to this an audio facility and the result is a colour monitor which sounds as good as it looks.

Finally, perhaps the best news for purchasers is that the CUB colour monitor represents a real investment. However dramatically computers or video systems may change in the coming years the means of displaying their output is unlikely to alter – you can't improve on the best.

Find out just how inexpensive quality can be by calling at your local computer dealer. Alternatively, contact Microvitec direct for full details of the breathtaking range of CUB colour monitors.

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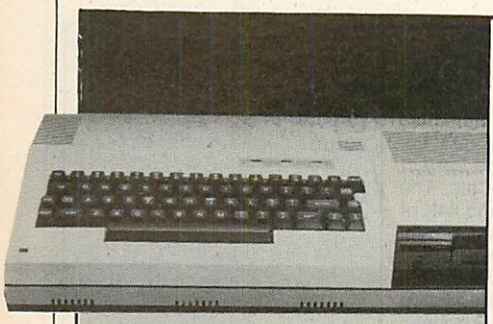
Transportables: top 20



PIED PIPER £1,066

Competitively priced eight-bit semi-transportable coming with good bundled software. Built around the Z-80A processor the Pied Piper comes with CP/M 2.2 and utilities and four packages from the Perfect range — Writer, Speller, Filer and Calc. The price also includes a fabric carrying case. The Pied Piper price does not include a screen but the system works with a standard monitor. An optional adaptor allows a reduced-width display, only 40 columns as opposed to 80 with a domestic TV. The weight of the Pied Piper main unit is 15lb. A built-in 5.25in. double-sided floppy drive provides 784K of usable storage. A second drive can optionally be fitted, and an external 10Mbyte hard disc is available, price £1,480. Standard RAM is 64K.

For. Good bundled software. Can read formats of some other machines.

Against. Only semi-portable. Requires separate monitor. Limited RAM expansion.

SORD M-23P £1,695

Unusual Japanese eight-bit transportable with optional large LCD panel. Built around the Z-80A processor the Sord comes with a Sord-written Basic and the company's Pips spread-sheet/database package. UCSD p-System and Lifeboat Associates' CP/M-compatible SB-80 operating system available as options.The Sord weighs 19lb. and has two 3.5in. microfloppy drives providing a combined 580K of storage. Display is via separate optional monitor, with colour output provided, or for £1,695 the system can be made fully portable with a 12in. long, eight-line by 80-character liquid-crystal display panel which costs £550. The Sord M£23P is one of the few Japanese offerings in the transportable sector of the market.

For. Good disc and memory capacity for its weight. Liquid-crystal display.

Against. Not exceptional value. Not mainstream CP/M.

TELETOTE £1,695

Eight-bit transportable that easily links into a local area network as well as functioning as a stand-alone CP/M machine. Built around the Z-80A processor, the Teletote comes with CP/M 2.2, Telewrite, Telecalc, and Telechart. The machine weighs 25lb. and has a 9in. yellow screen capable of displaying 640-by-240 dot graphics. Two 5.25in. floppy drives each provide 370K formatted disc capacity, while standard memory is 64K, expandable to 128K. The screen's graphics capacity is supported by the GSX-80 CP/M extension, which also comes with the system. An optional interface allows the Teleport to be linked to Televideo's local area network.

For. Good graphics. Large screen. Good software bundle. Network option. Televideo name.

Against. Bulky shape.

WREN £1,000

Competitively priced eight-bit transportable with built-in modem and good set of software packages. Built around the Z-80B, fast 6MHz version of the eight-bit processor, the Wren comes with CP/M Plus, Perfect Writer, Perfect Filer and Perfect Calc plus an executive desk-top diary/scheduler program. The machine weighs under 20lb. and has a built-in 7in. amber screen and twin 200K 5.25in. floppy drives. Standard RAM memory is 64K expandable to 256K. The modem is BT approved, connects into a standard telephone socket, and can handle dialling automatically. The screen's graphics capacity and the communications software that also comes with the system, make the Wren suitable for use as a viewdata terminal.

For. BT approved autodial modem. Good value with the software thrown in. Works as Prestel terminal or CP/M micro.

Against. Keyboard not detachable.

ZORBA £1,395

Competitively priced eight-bit transportable with 16-bit option available, and good range of software included in price. The Zorba is built around the Z-80A eight-bit chip and a standard 64K of memory, and comes with CP/M 2.2, WordStar, Mailmerge, Calcstar and various utilities. The machine weighs 21lb. and has a 7in. green screen and twin 400K 5.25in. floppy drives. The standard Zorba can read or write discs in a variety of other machines' formats. The Zorba 2000 has a 9in. screen and twin 800K floppy drives, and costs £2,195. A 16-bit 8086 upgrade card costs £595 and adds 128K of RAM to the standard system, which then acquires the ability to run CP/M-86 or MS-DOS software while retaining CP/M 2.2 capacity.

For. High-capacity floppy disc. Ability to read other disc formats. Good value with the software thrown in. Upgradeable to 16-bit.

Against. Looks plasticky.

Transportables: top 20

KAYPRO £1,520

Competitively priced eight-bit transportable with hard-disc option and good bundled software. Built around the Z-80A, the Kaypro comes with CP/M 2.2, Profit Plan, Basic and Perfect Writer, Perfect Speller, Perfect Filer and Perfect Calc. The machine weighs 26lb. and has a 9in. green screen and 64K of RAM. The base model, the Kaypro 2, has two 200K 5.25in. floppy drives, while the £1,847 Kaypro 4 has two 400K drives. The £2,595 Kaypro 10 has one 400K floppy drive and a built-in 10Mbyte hard disc. The Kaypro was recently voted Transportable Computer of the Year by seven European magazines, and is reviewed on page 68 of this issue.

For. Good software. Hard-disc model particularly good value.

Against. Bulky. Unattractive.

MACINTOSH £1,800

Apple's new 16-bit wonder machine, the Macintosh is actually transportable. The mouse, main unit and keyboard all pack into a fabric holdall. Built around the Motorola 68000 processor, the Macintosh comes with a Lisa-like integrated operating system. Standard RAM is 128K, expandable to 512K. Software packages already announced include Multiplan, Macpaint, Macwrite, Macterminal, two Basics and Pascal. Data can generally be copied between packages. The machine weighs 21lb. and has a compact A4 desk-top footprint, excluding the keyboard. The built-in 9in. black and white screen has 512-by-342 dot resolution. A single 3.5in. Sony microfloppy drive provides a formatted storage capacity of 400K. MS-DOS and add-on external disc drives promised.

For. Easy and fun to use. Fast. Chic.

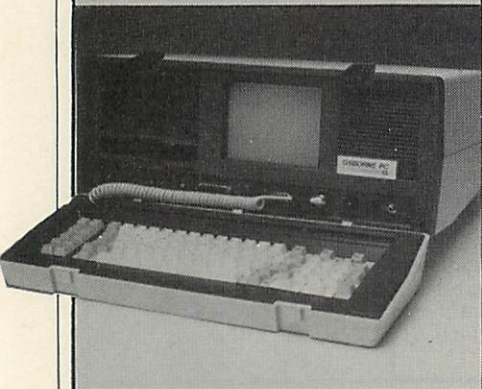
Against. Very new.

MERLIN £1,690

The Merlin is actually a standard Apple IIe main board boxed up with disc drives and 5in. monochrome display. The Merlin is based around the eight-bit 6502 processor and comes provided with Apple DOS and Applesoft Basic. The machine weighs 25lb. and has two TEAC 143K drives and a built-in 5in. black and white screen, with the normal Apple video output socket also available. Various options are available, mainly designed for Apple users in an industrial environment. For £1,985 the Merlin is available with 128K of bubble memory replacing one of the disc drives. A built-in 40-character wide tally-roll printer is also available. The Merlin is likely to appeal to industrial and technical users rather than the general user.

For. Complete Apple II software compatibility. Takes Apple cards. Bubble-memory option available.

Against. Specialised.



OSBORNE £995

The original ugly transportable has developed into a range of machines. The current main model is the eight-bit Z-80A based Osborne Executive — although the Osborne 1 with its 5in. screen is still available for as little as £995. The Executive has a 7in. amber screen and two 200K 5.25in. floppy drives for a price of £1,695, and weighs 28lb. With two 400K drives it costs £1,995. Standard RAM is 128K. All the Osbornes come with CP/M 2.2, the UCSD p-System, WordStar, Mailmerge, Supercalc and two Basics, and the Executive also has CP/M Plus and Personal Pearl in the price. The Osborne PC pictured here is scheduled for availability in the summer and is an 8088-based machine claimed to be IBM PC compatible with a price expected to be around £2,500.

For. Good bundled software.

Against. Fixed keyboard. Quite heavy. Very cheapest models have small screen and poor disc capacity.

PHILIPS P-2000C £1,290

Eight-bit transportable running CP/M software from big-name manufacturer. Built around the Z-80A processor the Philips P-2000C comes in a variety of disc and software configurations, all with CP/M. The entry-level system has two 160K 5.25in. floppy drives and comes with just CP/M 2.2. A more typical business model is the 2012, with two 640K floppy drives and word-processing, spreadsheet and database software bundled in for £1,690. All models weigh around 33lb. and have a 9in. green screen which can display 512-by-252 dot high-resolution graphics. Standard RAM is 64K, expandable to 320K. The Philips P-2000C has a fairly conservative specification but represents a price breakthrough compared to Philips' previous computing efforts.

For. Not ugly. Reasonable value.

Against. Heavy.

(continued on next page)

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Kaga 12" RGB Colour Monitor (Hi-Res)	K12R2
Kaga 12" RGB Colour Monitor (Super Hi-Res)	K12R3
Kaga 12" RGB Colour Monitor for IBM PC (Hi-Res)	K12R3PC
KAGA ACCESSORIES	
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RGB Interface Card and Cable for Apple IIe	RGB/A2e
Multi-Mode RGB Colour Card for Apple II (inc cable)	RGB/A24
Multi-Mode RGB Colour Card for Apple IIe (inc cable)	RGB/A24e
RGB Cable for Apple III to Kaga RGB Vision Series	RGB/A3
RGB Cable for IBM P/C to Kaga RGB Vision Series	RGB/IBM
BROTHER PRINTERS	
18 cps Daisywheel Printer (Parallel)	HR15/P
18 cps Daisywheel Printer (Serial)	HR15/S
Keyboard Attachment for HR15	KB50
Tractor Feed for HR15	TF50
Cut Sheet Feeder for HR15	CF50
EPSON PRINTERS	
Epson FX80 Dot Matrix (160 cps)	FX80
Epson FX80 Adjustable Tractor	FX80T
Epson RX80 Dot Matrix (100 cps)	RX80
Epson RX80FT Dot Matrix (100 cps)	RX80FT
Epson MX100 Type 3 Dot Matrix (100 cps)	MX100
Epson FX100 Dot Matrix (160 cps)	FX100

INTERFACES

DESCRIPTION	ORDER CODE
EPSON INTERFACES	
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RGB Cable for BBC to Kaga RGB Vision Series	RGB/BBC
Epson Graphics Card + Cable For Apple II & IIe (Suitable for MX, FX & RX range)	EP/APP2
Epson RS232 I/F Card (Suitable for FX & RX range)	8143
Epson RS232 I/F Card + 2K Buffer 75-9600 baud DTR handshake (Suitable for MX, FX & RX range)	8145
Epson RS232 I/F Card Type 3 + 2K Buffer 75-300 baud Xon/Xoff (Suitable for MX, FX & RX range)	8146
Epson RS232 I/F Card + 2K Buffer (Suitable for FX/RX range)	8148
Epson IEEE-488 I/F Card (Suitable for MX, FX & RX range)	8161
Epson IEEE-488 I/F Card (Suitable for FX/RX range)	8165
Epson 2K Parallel Buffer (Suitable for FX/RX range)	8171
Epson TRS-80 I/F board (Suitable for MX, FX & RX range)	8120
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Ribbon for Epson MX100 printer	EP100/R
Epson – BBC Parallel Cable	EP/BBC
APPLE INTERFACES	
CCS Serial Interface Card	CCS
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CPS Printer Cable (Please Specify)	CPS/P

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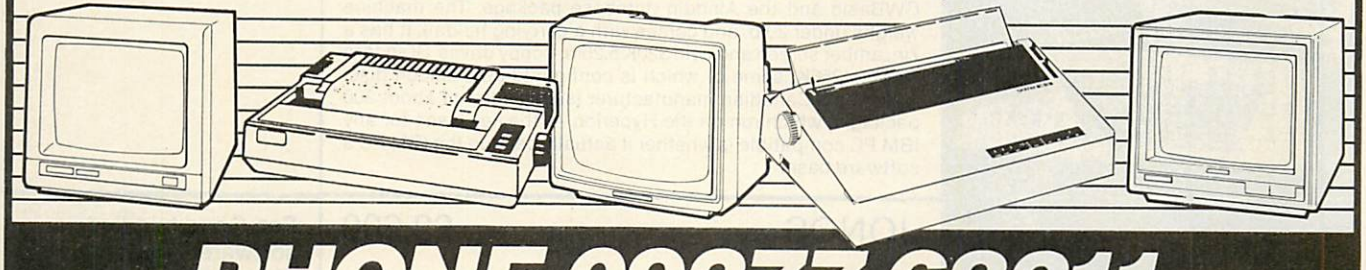

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Transportables: top 20

EAGLE SPIRIT £2,795

A 16-bit transportable claimed to be IBM PC compatible, available in floppy- and hard-disc versions. The Eagle Spirit PC has two 5.25in. floppy drives providing 360K of storage each, while the hard-disc Spirit XT has a 10Mbyte Winchester replacing one of the floppy drives. The price of the hard-disc version is £4,200. Both models are built around the 8088 processor, and come with MS-DOS, CP/M-86 and GWBasic. Both models also have a 9in. monochrome screen offering 720-by-352 dot high-resolution graphics capacity, with a colour board fitted as standard generating an RGB signal to drive an optional external monitor. Standard RAM is 128K, expandable to 640K. The Eagle Spirit PC weighs around 30lb., with the Spirit XT slightly heavier at 33lb.

For. Good graphics. Claimed to be IBM PC compatible. Hard-disc option.

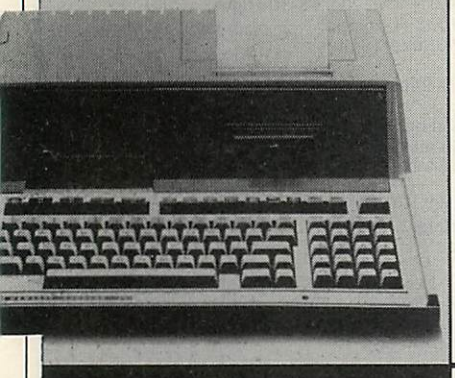
Against. Heavy. Pricey.

FOX £2,517

Fairly expensive eight-bit transportable designed to link easily into a local area network. Built around the Z-80A, the Fox comes with CP/M 2.2 so it can function happily as a stand-alone machine. It weighs 30lb. and has a 9in. green screen and two 5.25in. floppy drives giving a combined capacity of 1.2Mbyte. Standard memory is 64K. The Fox is fitted with a simple plug connector for Hinet, a local area network system from Digital Microsystems, part of the Extel group. Hinet can link up to 32 stations, which can be Foxes or other compatible machines. The Fox comes without bundled software apart from CP/M.

For. Easily connected into Hinet network.

Against. Heavy. Expensive. Only worth considering for networking.



HEWLETT-PACKARD 85B £2,554

Expensive eight-bit transportable of special interest to scientists and engineers. Built around a custom-designed HP eight-bit processor, the HP-85B comes with an HP Series 80 operating system and a very good Basic. The machine weighs 20lb. It has a 5in. screen which displays text across 32 columns, a built-in 32-column thermal printer capable of dumping screen graphics, and a 210K digital cassette drive with random-access capability. Standard RAM is 32K with another 32K, optionally expandable to 512K, configured as a silicon disc. Coupled with HP Basic's ability to handle very long strings, the silicon disc allows very rapid data transfer in data-logging applications. The HP-85B is fitted with the IEEE-4888, with many other interface options available.

For. Good Basic. HP name. Connects to a wide range of instruments.

Against. High price. Small screen. Fixed keyboard. For specialists only.

HYPERION £2,599

Expensive but well built and compact 16-bit transportable claimed to have a high degree of IBM PC compatibility. Built around the 8088 processor the Hyperion comes with MS-DOS 1.25 and is claimed to run most IBM PC software which does not use high-resolution graphics. The price includes GWBasic and the Aladdin database package. The machine weighs under 20lb. and comes with a carrying-holdall. It has a 7in. amber screen and twin 320K 5.25in. floppy drives. Standard RAM is 256K, some of which is configured as a silicon disc. Hyperion's Canadian manufacturer issues a list of about 300 packages which run on the Hyperion — the key issue for any IBM PC compatible is whether it actually can run the IBM PC's software base.

For. Compact. Stylish and probably fairly IBM PC compatible.

Against. High price.

JONOS £2,600

Transportable with a bewildering array of processor and disc options. The Jonos 2100 is built around the fast Z-80B processor. It comes with CP/M 2.2, Spellbinder, Spellcheck, Multiplan and Basic included in the price. This model weighs 27lb. and has two 3.5in. Sony microfloppy drives, each providing a formatted capacity of 322K. Standard RAM is 64K, expandable to 128K. The Jonos 2500 model is a similar machine but with two 5Mbyte hard discs, one fixed and one removable. It costs £4,995. Many other disc options are available. The Jonos I series models are built around the 8088 processor and claim IBM PC compatibility. The base model here is the Jonos 2150, which costs £3,395 with two Sony drives and 128K of RAM.

For. Good bundled software. Wide range of high-capacity disc options. Some models claim IBM PC compatibility.

Against. Typical transportable styling. Not cheap.

(continued on page 131)

PHILIPS

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Feature Highlights

1. 9" screen, 24 x 80 display, 32 KB video RAM
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4. CP/M* and p-System** provide access to a large range of available software
5. Interfaces: serial printer, external floppy drives, hard disk, data communication, slave monitor, IEEE-488

* CP/M is a trademark of Digital Research Inc.

** p-System is a trademark of Softech Microsystems Inc.

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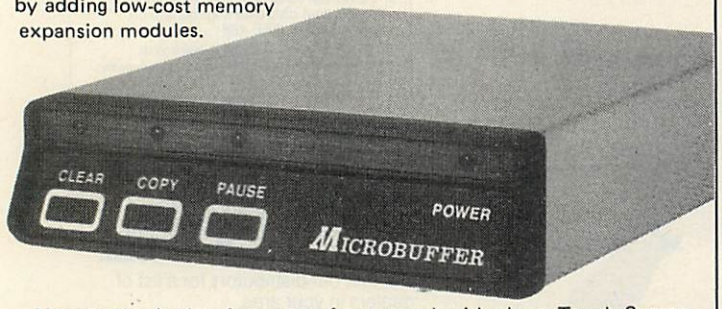

Microbuffer In-line features a front panel with three Touch Sensor controls; one to clear the buffer, one to perform complete self-test, and a copy botton to reproduce the last document up to 256 times without any computer intervention. (When a document takes several hours to prepare and a copy machine isn't available, this feature can save a great deal of time.)

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(Supports hardware handshake + XON/XOFF up to 19200 baud)
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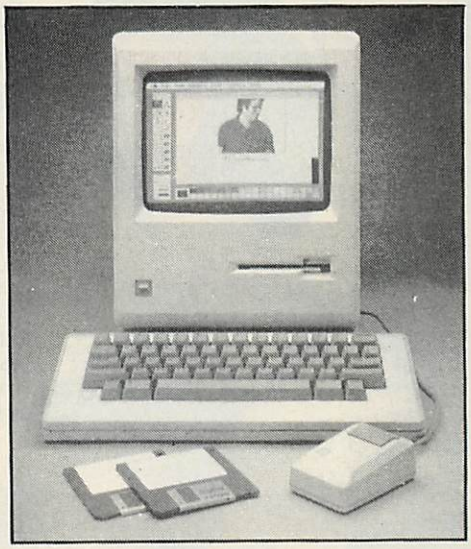
64K Gram Serial/Parallel £218 + VAT

The Apple Macintosh



Peter Fisher of Pete & Pam says "I've been using a Macintosh for a couple of weeks now. The machine is excellent. It's fast, using a 32/16 bit 68000 processor, and has many superb features, employing software techniques that are years ahead of competitors. The mouse pointer and "pull-down" menus make the machine one of the easiest to learn I have come across. I recommend that every potential purchaser of a micro computer for personal/business/office use see the MACINTOSH before making a decision. Ask for a copy of a 10 page review now.

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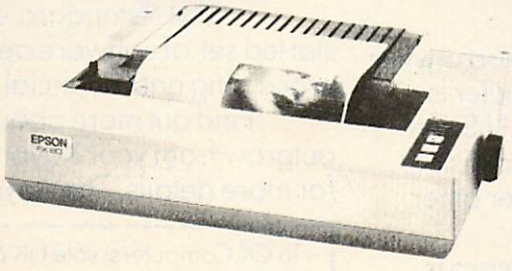
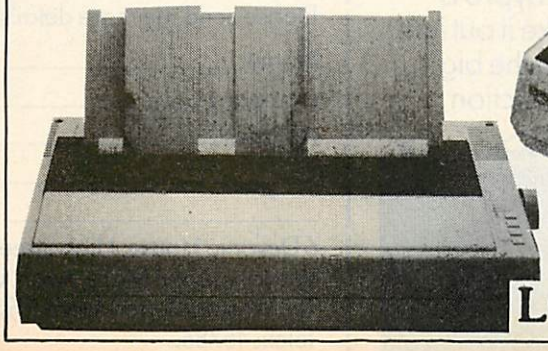


RX-80



LQ-1500

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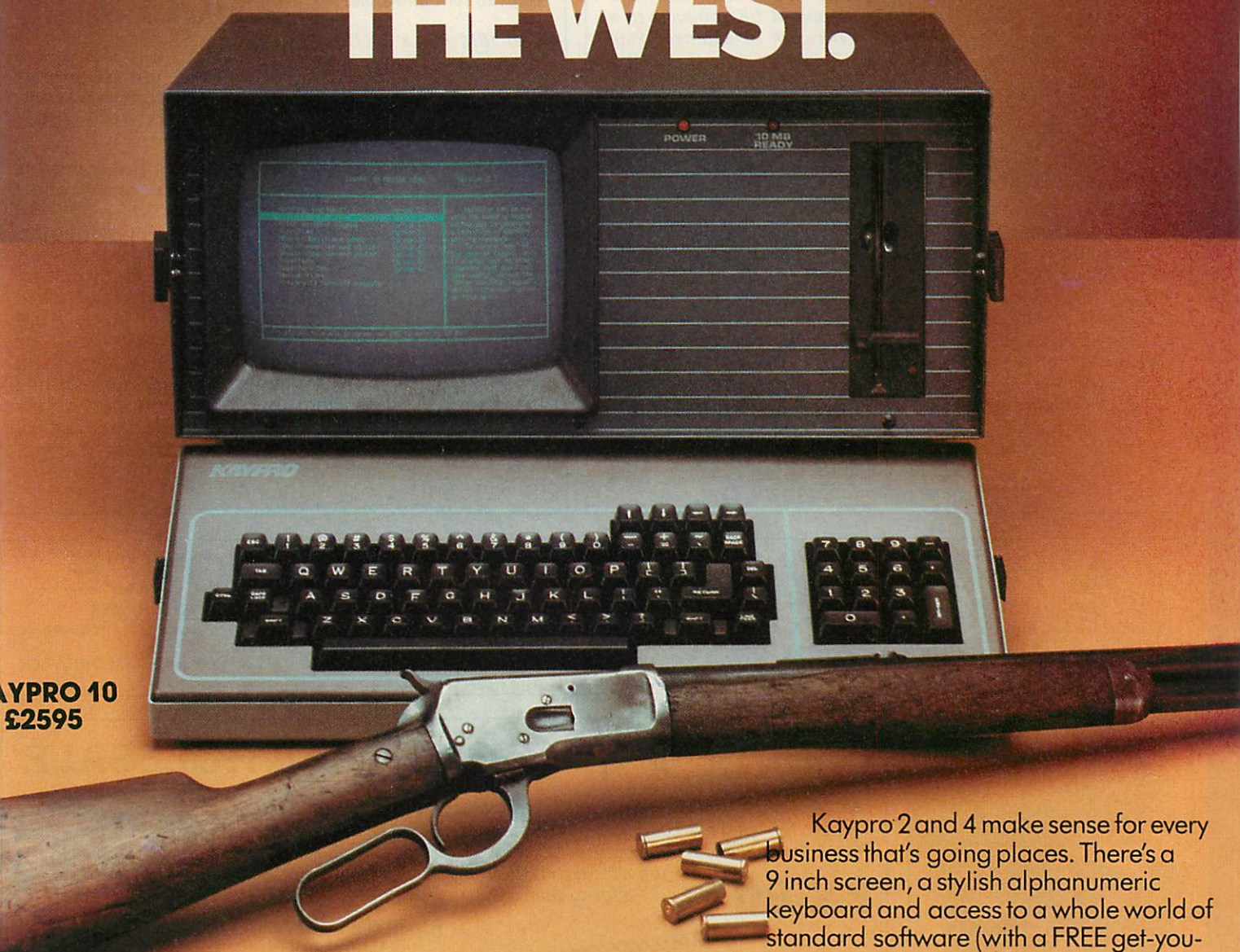


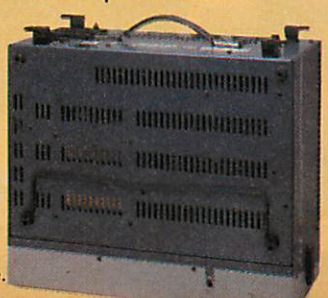
YPRO 10
£2595

Winchester Disks. That's the short answer why the Kaypro 10 professional computer is rving out big market territory for itself in the U.S. ten Megabytes of integral hard disk storage give it the edge over other systems in its price bracket.

9" screen that's easy on the eye.

And because the Kaypro is truly portable you can take it out into the field with you to tackle the big challenges head on: production heduling, sales performance nalysis, technical processing or wherever real memory orage is vital.

More bang for your buck n't the only reason why the aypro 10 and the floppy disk



Packs away into a light steel carrying case.

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Transportables: top 20

APRICOT £1,690

Competitively priced, compact, 16-bit semi-transportable with good range of software available. Built around the 16-bit 8086 processor. The Apricot price includes Supercalc and Superplanner, MS-DOS 2, CP/M-86, Concurrent CP/M-86, two Basics and various utilities. The machine packs up into two units — the system box and keyboard, together weighing 17.5lb., and the separate 9in. green screen which weighs 9lb. The entry-level Apricot has one Sony 3.5in. microfloppy drive providing 315K of storage; for £200 more the system comes with a second drive. Standard RAM is 256K, expandable to 768K. The Apricot is very similar in software terms to the ACT Sirius, and a good range of business application packages are available for it.

For. Compact. Stylish. Good software availability. Lots of internal memory.

Against. Disc access seems slow. Takes two hands to carry.

COLBY £995

The ultimate portable for IBM PC compatibility: the Colby is simply a box ready to accept genuine IBM components taken from an IBM PC. For your £995 you get the portable case already fitted with 9in. amber screen, video controller and power supply, and the Colby keyboard which also functions as a lid when the system is packed up. Any missing bits can be taken from a cannibalised PC or bought from an IBM retail centre. IBM will supply the necessary components to end-users but you usually have to wait about 10 weeks. You require the PC main board, which costs about £355, two half-height drives, £375, the disc controller, £150, and a monochrome video/printer board, £247. The assembled system weighs 26lb.

For. The only genuine 100 percent IBM PC compatible portable.

Against. Heavy. Not cheap. Delay likely in getting IBM components. Not a straightforward consumer purchase.

COLUMBIA VP £2,475

A 16-bit transportable claimed to have a high degree of IBM PC compatibility. Built around the 8088 processor the Columbia VP comes with MS-DOS 1.5, CP/M-86, various utilities and the Perfect range of application software, Perfect Writer, Perfect Speller, Perfect Filer and Perfect Calc. The machine weighs a hefty 32lb. and has a 9in. amber screen. The screen can display 640-by-200 dot high-resolution graphics. Twin 5.25in. floppy drives provide 320K of storage per drive. Standard RAM is 128K, expandable to 256K. One internal expansion slot is claimed to have IBM PC plug compatibility.

For. Good bundled software. Claimed to be IBM PC compatible.

Against. Heavy. Pricey.

COMMODORE SX-64 £778

Eight-bit transportable derived from the Commodore 64 home micro. Built around the 6510 processor the SX-64 is identical in software terms to the Commodore 64. Easifile, Easiscript, Future Finance and the High Flyer business game come with the system. The machine weighs 25lb. and has a built-in 5in. colour screen and a 5.25in. floppy drive, capacity 174K. The SX-64 also has a cartridge port, so it can accept Commodore 64 software on disc or cartridge, but it lacks a cassette interface. Standard RAM is 64K, expandable to 256K. An optional Z-80 CP/M card is available but the SX-64 is still an unconvincing business machine. The small screen only displays text across 40 columns, and looking at text soon becomes tiring.

For. Colour display useful for graphs and games. Serial port.

Against. No cassette port. Display unsuitable for business text applications.

CORONA PORTABLE PC £2,295

Another 16-bit transportable which claims IBM PC compatibility. Built around the 8088 processor the Corona portable PC comes with MS-DOS 1.25, the Multimate WP package. PC Tutor tutorial package and GW Basic. The machine weighs 30 lb. and has a 9in. green screen capable of displaying 640-by-325 dot high-resolution graphics. The entry-level machine has one 5.25in. floppy drive, capacity 320K. The twin-drive model costs an extra £330. A 10Mbyte hard disc which fits inside the case is also available. Standard RAM is 256K, expandable to 512K. Four expansion slots are provided, which are claimed to have IBM PC plug compatibility.

For. Good graphics. Claimed to be IBM PC compatible.

Against. Heavy. Pricey.

(continued on page 129)

Ugly ducklings

Ian Stobie introduces our top 20 selection, and raises some doubts about the future of heavy, mains-powered transportable micros.

MAINS-POWERED transportable computers are generally pretty unpleasant looking things, and, if the truth be told, generally fairly difficult to move too.

The transportable provides all the elements of a complete computer system, though usually not a printer. Screen, disc drives, keyboard and processor board are simply shoved into a box with a carrying handle on it, and a single power cable coming out of the back.

The concept of an all-in-one package has prompted most transportable manufacturers to bundle in software with their systems. Often this provides very good value for the purchaser. Most transportables run either standard CP/M or MS-DOS, so abundant business software is available to supplement packages supplied with the system.

Budget buys

Software bundling is less common with static desk-top office systems, while the chic new battery machines are handicapped by non-standard operating systems or use some weird mass-storage system in place of standard disc drives. The transportable is really putting itself forward not for its rather debatable degree of portability, but as a good budget business system.

The plasticky-looking but reliable Zorba transportable, for instance, comes with

good-quality word processing and spreadsheet packages for £1,395, and accepts discs produced on a variety of other machines. The £1,000 Wren looks ugly but it comes with some of the same software packages and has a BT-approved built-in auto-dial modem, making it suitable for use as a Prestel terminal as well as a standard business machine.

Nonetheless, these budget workhorses are likely to be a fairly transitory product category. The present mains-powered transportable concept is being squeezed by the growing capabilities of battery portables. This pressure is likely to be increased when BT approval for equipment that connects directly to the phone lines starts coming through, and computer applications which the truly mobile battery portable is better able to handle start taking off in the U.K.

Meanwhile the ordinary stay-at-home office machine looks likely to begin mutating into a transportable. The Macintosh and the Apricot represent the beginnings of this development. The Macintosh is intended for common office tasks and has been carefully designed to sit compactly on the desk top. But while they were at it, Apple's engineers made the Macintosh into a transportable computer as well, and a very elegant one.

When the requirement dictates a compact main unit, perhaps using Sony microfloppy disc drives, with a single power cable to make the system easy to set up, then little extra effort is needed to come up with a transportable system, which is what Apple did. The Macintosh at 21lb. is lighter than the majority of machines in this survey, while at the same time it embodies what many people regard as the state of the art in easy-to-use computing.

Our top 20 selection starting on the next page obviously leaves out some quite adequate machines. In particular those which have made little market impact, and American models not available on this side of the Atlantic, are not included.

Suppliers

Apricot: ACT (U.K.) Ltd, Shenstone House, Dudley Road, Halesowen, West Midlands B63 3NT. Telephone: 021-501 2284

Colby: Microware (London) Ltd, 637 Holloway Road, London N19 5SS. Telephone: 01-272 6398

Columbia VP: Icarus Computer Systems Ltd, Deane House, 27 Greenwood Place, London NW5 1NN. Telephone: 01-485 5574

Commodore SX-64: The Commodore Information Centre, 675 Ajax Avenue, Slough, Berkshire SL1 4BG. Telephone: (0753) 79292

Corona: Midlectron Ltd, Midlectron House, Nottingham Road, Belper, Derby DE5 1JQ. Telephone: (077382) 6811

Eagle Spirit: Geveke Electronics Ltd, RMC House, Vale Farm Road, Woking, Surrey GU21 1DW. Telephone: (04862) 26331

Fox: Digital Microsystems Ltd, Molly Millers Bridge, Molly Millers Lane, Wokingham, Berkshire RG11 2PQ. Telephone: (0734) 793131

HP-85B: Hewlett-Packard Ltd, PC Group, King Street Lane, Winnersh, Wokingham, Berkshire RG11 5AR. Telephone: (0734) 784774

Hyperion: Gulfstream Computer Group, Unit 3A, Tunnel Estate, 726 London Road, West Thurrock, Grays, Essex RM16 1LS. Telephone: (04026) 4926

Jonos: Jonos International Ltd, 5 The Curfew Yard, Thames Street, Windsor, Berkshire SL4 1PL. Telephone: (07535) 54272

Kaypro: CK Computers Ltd, Estover Close, Industrial Estate, Plymouth, Devon PL6 7PL. Telephone: (0752) 780311

Macintosh: Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7HQ. Telephone: (0442) 60244

Merlin: Xcalibur Computers Ltd, Spencer House, 3 Spencer Parade, Northampton NN1 5AB. Telephone: (0604) 21051

Osborne PC: Osborne Computer Corporation (U.K.) Ltd, 38 Tanners Drive, Blakelands, Milton Keynes MK14 5LL. Telephone: (0908) 615274

Philips P-2000C: Kingsway Data Systems Ltd, 30 Guildford Street, Chertsey, Surrey. Telephone: (09328) 68911

Pied Piper: Semi-Tech Microelectronics (Europe) Ltd, 145-147 Ewell Road, Surbiton, Surrey KT6 6AW. Telephone: 01-390 6177

Sord M-23P: Socius Computer Systems (U.K.) Ltd, Samuel House, St. Albans Street, Haymarket, London SW1Y 4SQ. Telephone: 01-930 4214

Teletote: Televideo Systems International Ltd, Silbury Court, 372 Silbury Boulevard, Witan Gate East, Milton Keynes MK9 2AF. Telephone: (0908) 668778

Wren: Prism Business Systems Ltd, Prism House, 18-29 Mora Street, London EC1V 8BT. Telephone: 01-253 2277

Zorba: Sun Computing Services Ltd, Concorde House, St. Anthony's Way, Feltham, Middlesex TW14 0NH. Telephone: 01-890 1440

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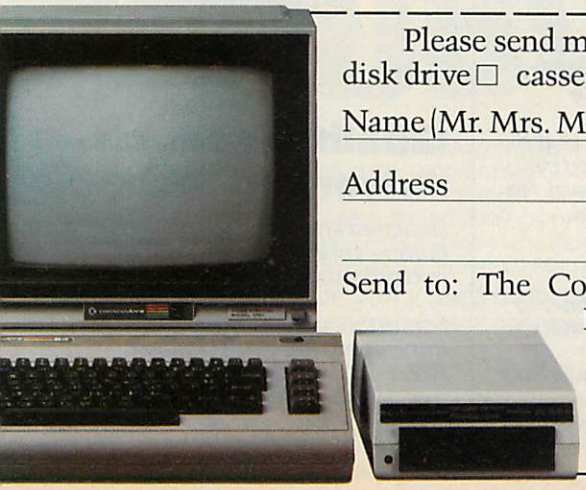

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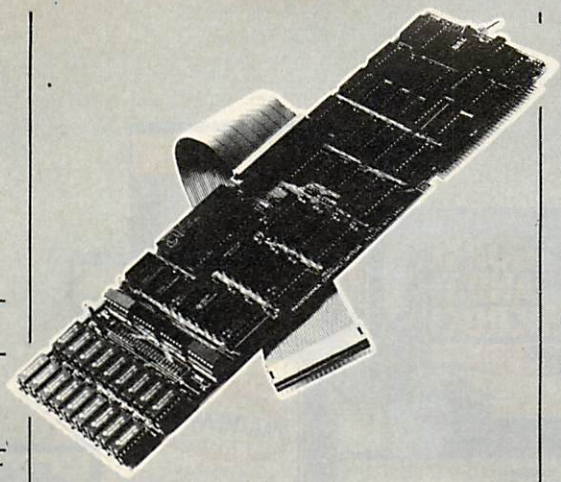

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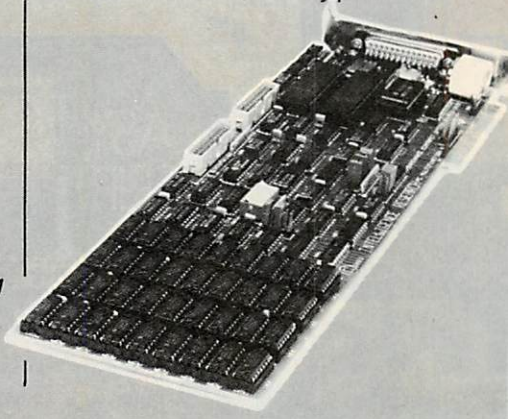

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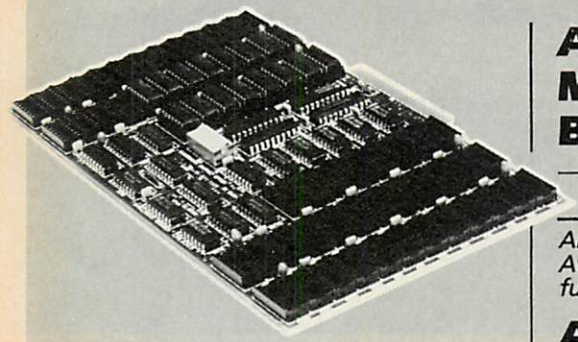
for IBM, Sirius/Victor and Apple computers



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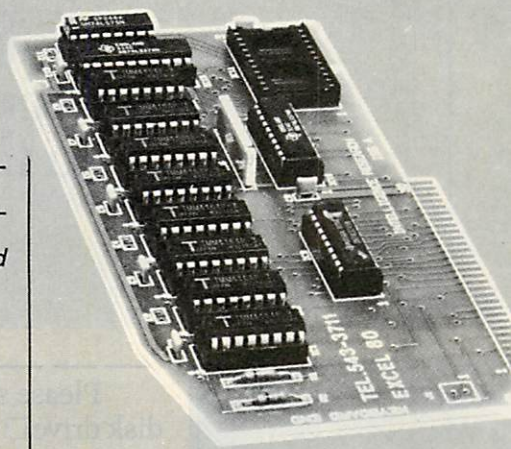

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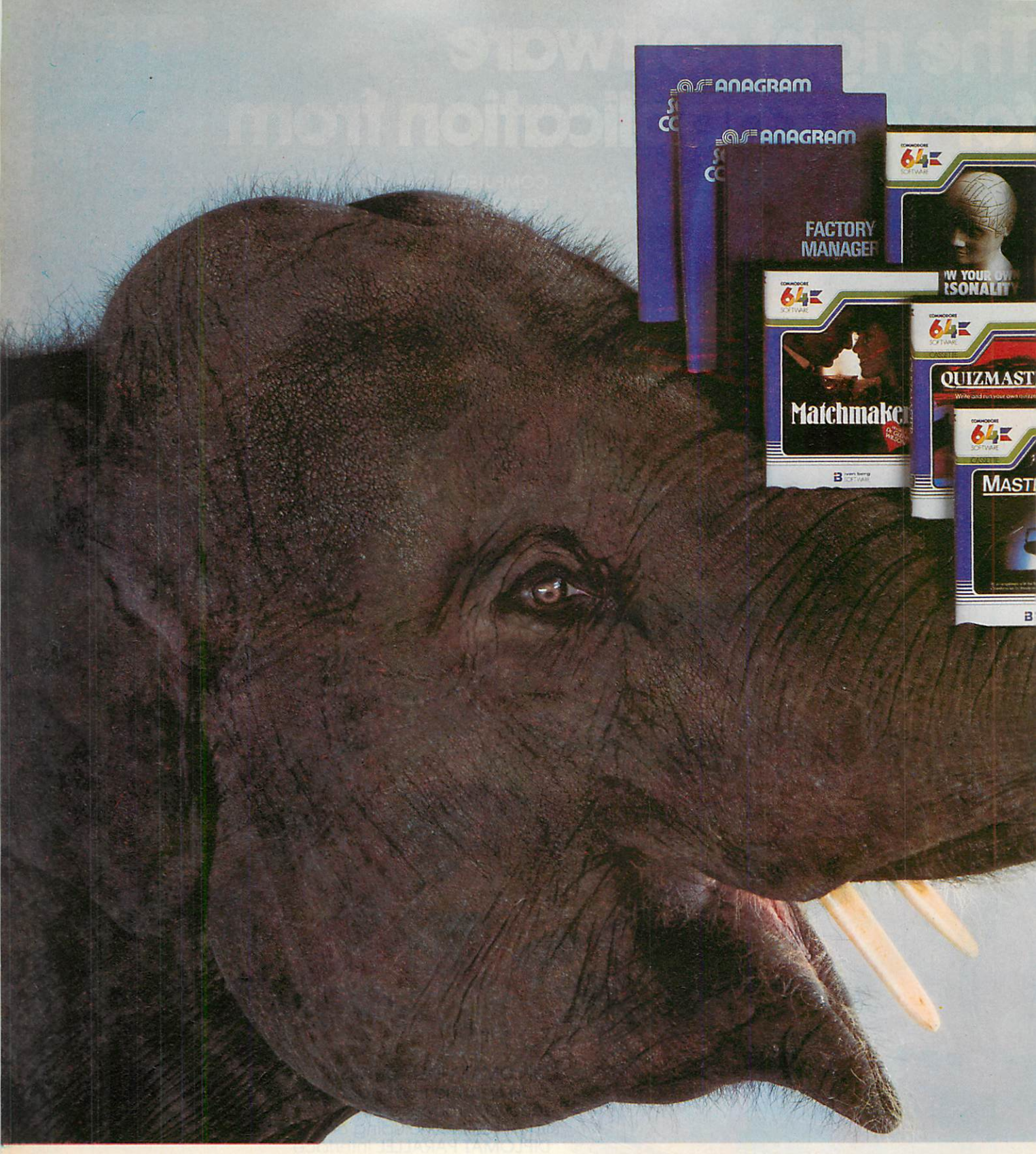


The problem with buying a home computer, as you may already have discovered, is there's often very little software to go with it. Or all that is available is games, games and more games.

There's no such problem, however, with the Commodore 64. It has a more extensive range of serious software than any other home computer.

It also has an unusually large (in fact elephantine) 64K memory, as well as every peripheral you're ever likely to need.

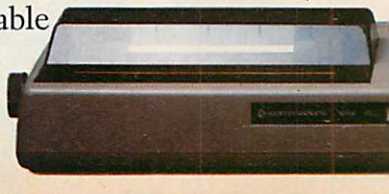
Put simply, this means the computer has the capacity to run more interesting, entertaining and complex programs.

You can teach yourself just about any subject you care to mention, even computer programming

And for the office there are programs like word processing, financial planning, information storage and stock control.

Finally, when you're mentally exhausted, you can even entertain yourself – yes, with games.

When all's said and done, however, we do have to admit that in one respect the Commodore 64 isn't up with the competition. It costs around £229, much less than any comparable machine.



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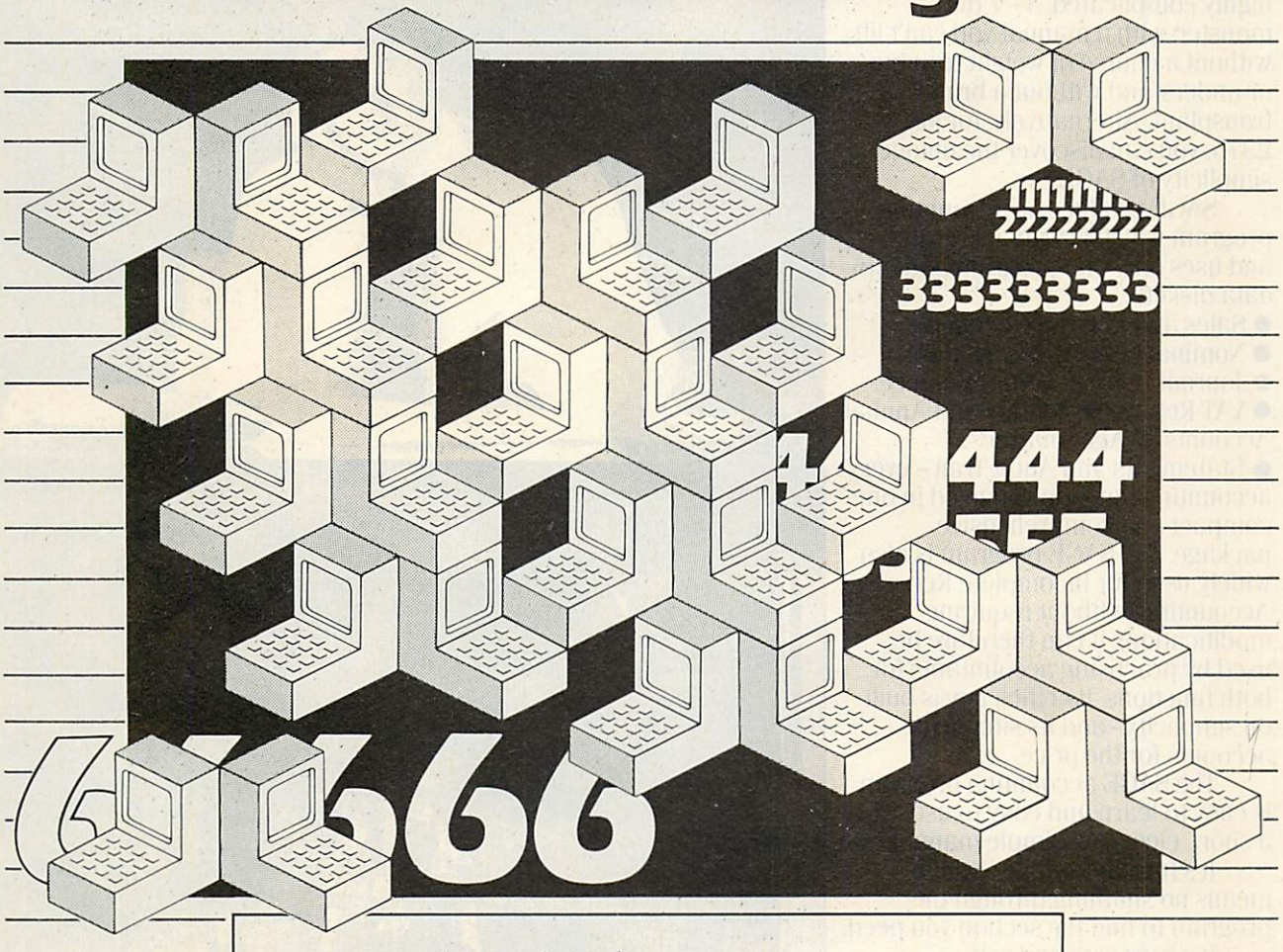

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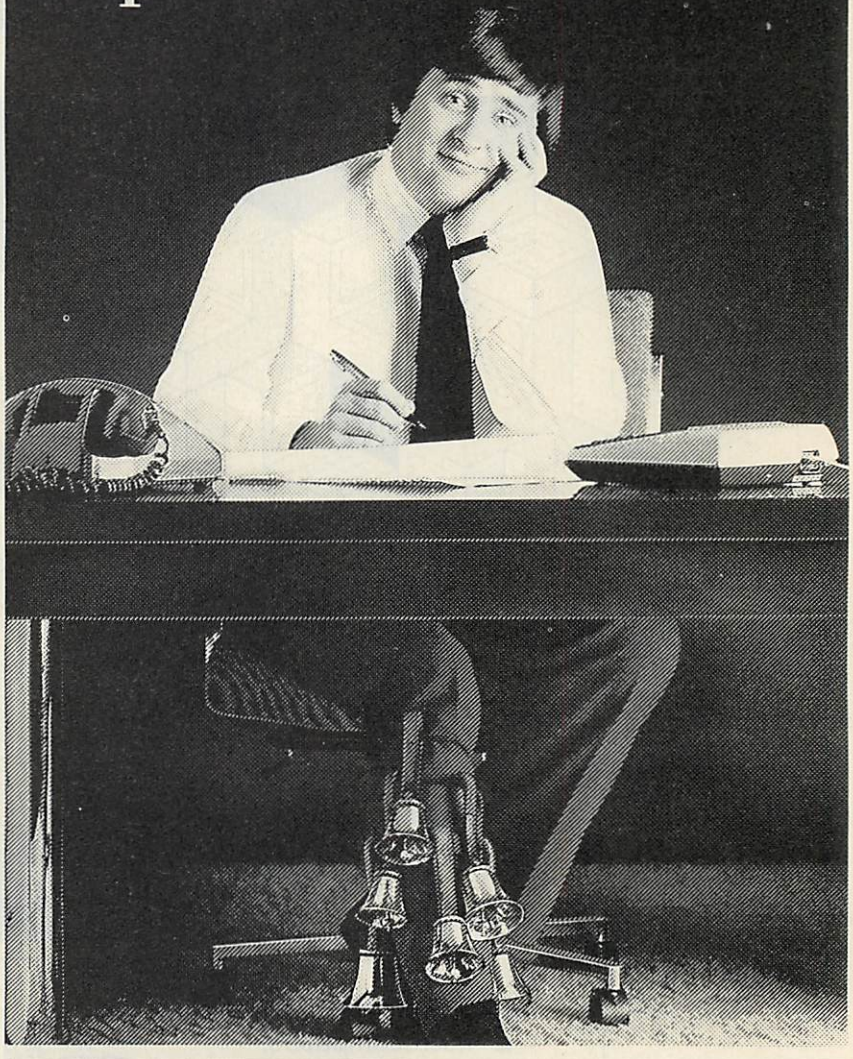

We kid you not.

The uninitiated can be led a merry dance by the bewildering choice of accounting programs currently on offer.

But don't put your foot in it by assuming that a high price guarantees you high efficiency.

You can, if you really wish, pay £1,000 or more for a sprawling, highly complicated, 4–7 disk monster, with a manual you can't lift without a course of weight training, or understand without a brain transplant. Alternatively, for just £375, you can discover the unique simplicity of SAGE.

SAGE produce an accounting program which is truly integrated and uses only one program and one data diskette.

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The SAGE accounting program is easy to learn and easy to use, with a short, clear and simple manual.

It's fully automatic – which means no shuffling through the program to find the section you need.

It's complete and self-contained – no expensive modules to buy every time you need an extra function.

It's suitable for use on CP/M or MS–DOS machines and has so far been implemented on Osborne, Superbrain, Epson QX–10, Sirius, Victor 9000, IBM PC, BBC/Torch Z80 and ITT with others in the pipeline.

What's more, the SAGE accounting program has been successfully tested in hundreds of installations and is the only system of its type – is as effective in a one-man business as in a multi million pound corporation.

Check it out and we'll prove to you that software doesn't have to be expensive to be efficient. Return the coupon and we'll send you more information and the name of your nearest dealer.

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accounting program

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● **Circle No. 154**

(continued from previous page)
microcomputer users is that it allows a machine with relatively modest amounts of storage — say 128K — to run as many as 12 active terminals at once. Provided they do not all want to carry out work at once, the natural optimisation of the virtual-storage concept will allow high utilisation from relatively small machines.

User interface

Apart from the report generator, the main user interface provided by Pick is the Terminal Control Language, TCL. It consists of over 200 utilities, some of which are used to maintain and tidy up the central database. Additionally, users can set up procedures consisting of lists of the commands made available by the Pick system. These commands provide the main way of controlling the operation of the system, and can be stored in procedures. The procedures can then be passed to the TCL utilities or to the other Pick facilities.

Pick includes an editor within which any element of data, including dictionary items, can be modified. It has full system accounting which provides details of CPU usage, pages printed and so on. There is a very powerful spooler which can handle 600 print files on up to 16 attached printers. It caters for multiple copies, immediate or delayed printing and spooling to tape.

The Pick security system provides options for the protection of accounts, files, commands and even devices. Pick provides a word processor called Jet, a text processor called Runoff, and a specific form of Dartmouth Basic called Databasic. This enhanced Basic compiler generates re-entrant code, includes programmer-development aids, a high-level interface to the relational database, direct output to the spooler and access to the query language.

This year should see the arrival of the long-awaited rewrite of Pick called Release 84. One of the innovations to be found in the new release will be a C compiler which should allow other operating systems such as Unix to run under Pick.

Although Unix will always find a home in many of the computers of the future, the attractive features of Pick mean that it too will create its own niche. In particular, its high degree of user-friendliness will ensure that large numbers of software suppliers will adopt it to cater for non-specialist users.

A simple enquiry . . .

```
LIST PERSONNEL WITH AGE > "23" NAME BIRTH.DATE SALARY DEPT
```

. . . produces a report in the following form . . .

```
PAGE 1                                                14:37  14 FEB 1983

RECORD    NAME              DATE OF BIRTH    DEPARTMENT          SALARY

 317      JONES D A          14 JAN 1951     QUALITY CONTROL      11800
1412      MORRISON B         01 MAR 1947     QUALITY CONTROL       8500
 113      FAIRCLOUGH A B     31 DEC 1958     PLANNING              4750
1123      JONES D K          15 MAR 1931     QUALITY CONTROL       8750
 882      SMITH B W          03 MAY 1949     PLANNING             11200
1417      MYERS J            21 JUL 1943     QUALITY CONTROL       8500
1110      JONES A F          12 FEB 1946     QUALITY CONTROL       8750
```

or you could use more complex enquiry to produce a more structured report:

```
SORT PERSONNEL WITH AGE > "25" AND WITH SALARY BETWEEN "5500" AND
"11500" BY DEPARTMENT BY SALARY BY AGE BREAK-ON DEPARTMENT TOTAL
SALARY NAME AGE HEADING "PENSION FUND MEMBERS WITH SALARY IN RANGE
5500 TO 11500" LPTR
```

IDM's Revelation is a Pick look-alike for the IBM PC. One of its most important features is a general-purpose retrieval language.

Suppliers

Pick is relatively new to the U.K. so the number of products now available is fairly limited. Probably the most significant are an implementation on the IBM PC from IDM, and the Crystal 68000 series from Aston Technology.

- Interactive Data Machines, Scawthorpe Hall, Great North Road, Doncaster, South Yorkshire. Telephone: (0302) 786677. Provides a Pick look-alike front end to PC-DOS for the IBM PC; also Apgen, a bridge between Unix and Pick.
- Aston Technology, Aston Science Park, Love Lane, Birmingham B7 4BJ. Manufactures the Crystal 68000 series, available with Pick as standard; also System Builder, an application generator based around Pick.
- Altos Computer Systems, Manhatten House, High Street, Crowthorne, Berkshire. Pick available on 536/10/40 range of computers.
- Consultants (Computer & Financial) plc, 2-12 Wilson Street, London EC2M 2TE. Various software packages running under Pick: shipbroking, commodity trading, stockbroking, investment management.
- Computer Factor (Sales) Ltd, Marshall House, Manor Road, Coventry CV1 2GF. Mailbrain II mail order processing on Pick machines.
- EDP Systems, 1 Tapton Park Road, Sheffield 10, South Yorkshire. Large number of commercial Pick-based packages available.

The man and his product

The Pick operating system was written by Dick Pick in the late 1960s. At the time Pick was working for TRW, having left Berkeley with an MBA, and having spent some time with Mattel Toys as a programmer. TRW had just been commissioned to develop a sophisticated database-management system to keep track of the Cheyenne helicopter project and set out to build a computer architecture geared towards data management and information retrieval.

There was at the time no definitive hardware specification, so the team built what Pick calls a "software machine". The result was a sophisticated data-retrieval and query system. By the early 1970s, this had been surrounded by an operating system that had many of the features that are so distinctive of Pick. They included its built-in relational database, variable-length data organisation, integrated word processor and a whole range of end-user and programmer tools.

The first major implementation of the complete Pick system came out as long ago as 1973, as Reality on Microdata hardware. Things have been quieter since then, but now there are over 20,000 users world-wide and a new product base built round the 68000 chip. Implementations are either here or due on most IBM machines from the PC to the large mainframes, and there is a growing band of vociferous supporters advocating its use.

Dick Pick himself has always had the reputation of a maverick within the computer industry. Even now, with a product that appears about to take off in a massive way, he is often said to appear somewhat wistful for the good old days of assembler programming. Dick Pick must take a lot of the blame for his operating system having been undersold in the past. He is unlikely to become the archetypal marketing executive, but the future of his creation seems assured nonetheless.

Non-procedural languages

The availability of powerful reporting facilities such as that provided under Pick means that, for microcomputer users, the conventional balance between package software and home-grown programs is radically altered. Hitherto it has been difficult to justify the expense of writing software. Not only is it a time-consuming and costly task, it requires end-users to delve into their computers. The use of non-procedural languages and tools against a background of a relational database as provided with Pick, now enables users to tell a computer what to do rather than how to do it. Thus it becomes possible for a user to write programs without first having to become a programmer.

Normal programming languages such as Cobol and Basic are termed as procedural languages. The name implies the necessity to code out a program in full detail. The program then directs the computer as to how a particular task should be carried out. Using a non-procedural language, it is merely necessary to direct the computer as to what is required. The language's supporting software works out in detail how this is to be done.

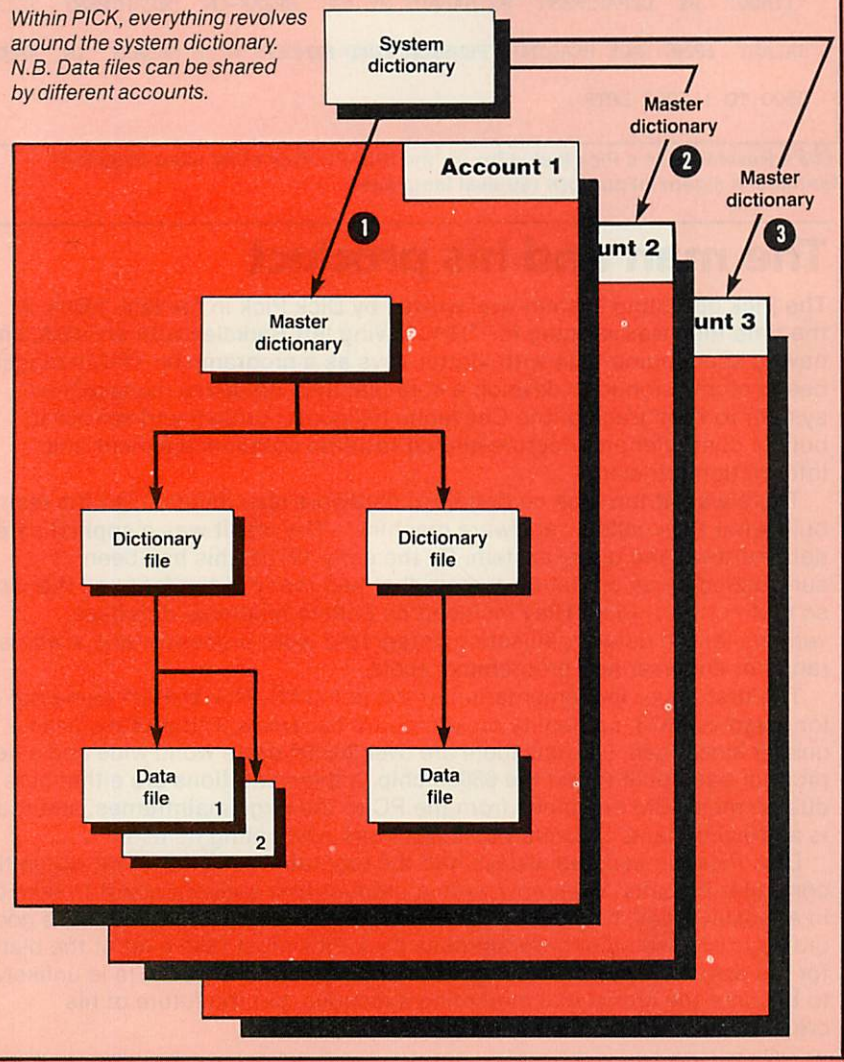
Using Pick's non-procedural language you can tell the computer something like

LIST ALL ACCOUNTS WITH ACCOUNT-BALANCE >£1000.00

rather than having to write a program telling the computer exactly how to do it. The availability of such powerful, non-procedural languages will eventually provide a realistic alternative to those users who are now limited by the constraints inherent in package software.

PICK — File structure

Within PICK, everything revolves around the system dictionary. N.B. Data files can be shared by different accounts.



All Pick files are organised in a relational manner. Associated with each file or set of files there is a data dictionary which defines the attributes of both the file and of all the fields within the file.

Two main advantages follow from the use of a data dictionary. First, the logical structure of the file is independent of its physical structure. So if you wished to lengthen a particular field or to add a new field to a file, it would merely be necessary to make a one-off change to the data dictionary. No change would have to be made to the file itself, and very few to the programs as they all access the file via the dictionary.

Secondly, it facilitates the use of very high-level enquiry and report facilities. A powerful, non-procedural, fourth-generation query language is supplied as an integral part of Pick. It features a natural, English-like command syntax, making it easy for the non-specialist end-user to perform complex enquiry and reporting tasks without having to write special programs.

The file organisation within Pick, allows many different users to keep files within the system. All the files within the system are structured into a series of accounts, one for each user on the system. Each account has a master dictionary which lists all of the subsidiary data dictionaries for the account. Access to data held in differing accounts is permitted.

Hashing

All data within Pick is stored using a hashing algorithm whereby only one disc access is required to read or write data records. This avoids the need for tree structure indexes, and speeds up access to all data items. Each data element within Pick is considered to be of a variable length. This applies not only to each file and to each field within those files, but also extends to the capability of having a variable number of sub-values within each field.

Many computers employ a virtual-memory system to provide relatively large storage capacities within reasonably sized real memories. This is done by placing large chunks of the virtual memory on disc and only calling them into the computer's memory when they are needed. Pick takes this concept further. As well as considering the computer's memory to be virtual, it also considers all the computer's data, including disc files, to be part of virtual storage.

Any computer running Pick has, potentially, up to 8Gbyte of local storage available. The only physical constraint is the available disc space. This is possible because of the natural optimisation that occurs when using virtual memory. For example, any user not currently active actually takes up little, if any, main storage — all the storage is held on disc until the user wants to use it again.

The main advantage of this concept for

(continued on next page)

All one big family

Russell Jones summarises the virtues of the operating system designed for the time when ample processing power blurs established computer categories.

EACH ADVANCE in microprocessor technology brings closer the end of that artificial barrier between micro, mini and mainframe computers. The new 16-bit and 32-bit chips are now forming the basis of compatible computer families, distinguishable only by their cost and performance, not by some nebulous name.

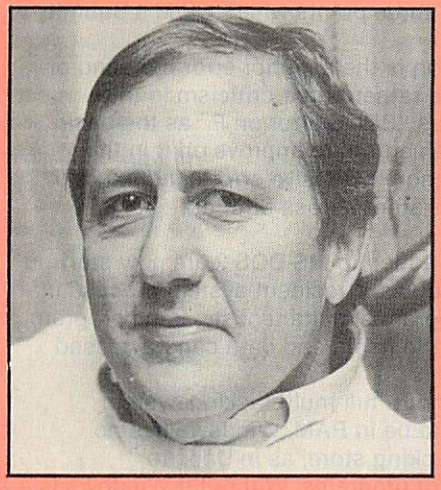
In such an environment, the need to develop operating systems that are not restricted to any particular machine becomes much more urgent. The most obvious example of such an operating system is Unix. It evolved as part of a larger research project but it now reigns as undisputed leader in nearly all academic, R&D and laboratory installations.

Pick is less well known. It initially formed part of computers being used by U.S. troops in Vietnam, where the primary requirement was for an ultra-high level of that old computer-industry cliché, user-friendliness. Unix was built by programmers for programmers: it provides a veritable battery of programming aids and tools, but is not exactly renowned for the accessibility of its user interface. Pick, on the other hand, was designed expressly to protect end-users from the vagaries of different computers and from needing to understand the details of how they work.

Basic needs

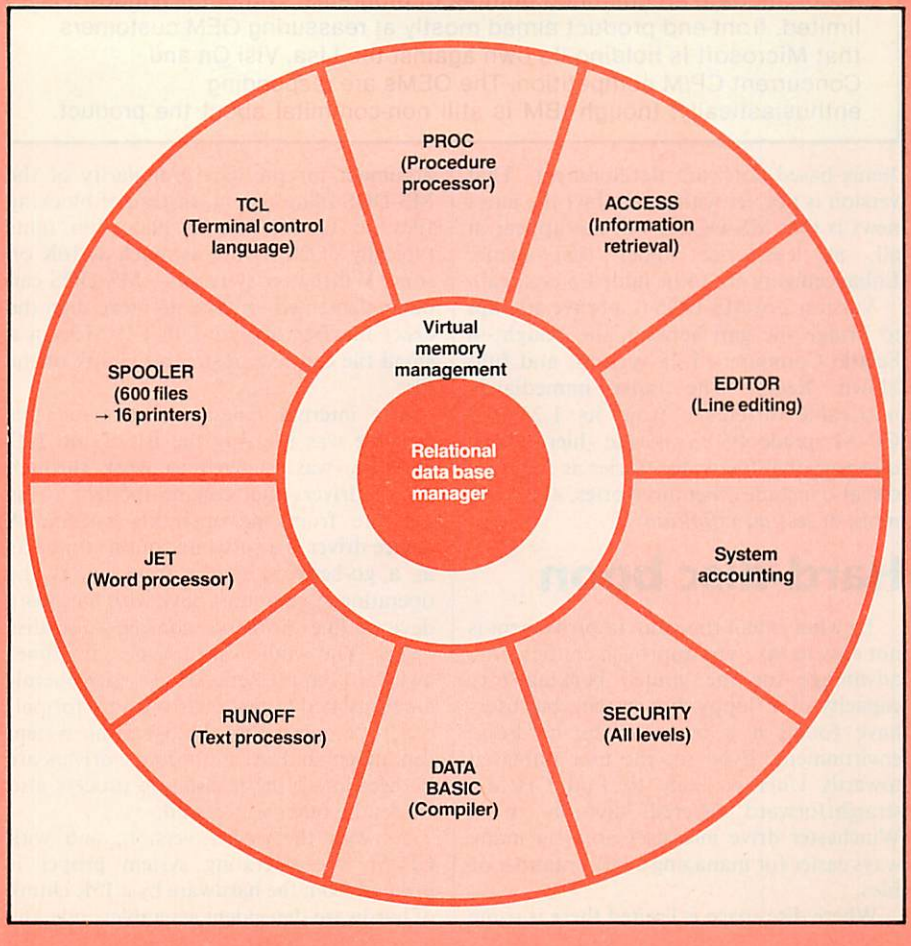
The originators of all too many operating systems seem to forget that the basic requirements of a computer are that it should be able to store and manipulate data in such a way that it is easily available to its users. Furthermore, they also forget that different users may want to look at the same data in different ways.

Somebody using an accounts system to post payments of different types to a ledger is likely to be interested in accessing the ledger via an account number of some sort. Somebody else within the company may be more interested in looking at a summary of such postings by payment type. By far the easiest way or organising data to enable such tasks to be done is via what is known as a relational type of database. Each element of data, such as a ledger entry, is reached by reference to some form of key, such as the number allocated to that particular posting.



In this example the types of posting could be held in a separate file indexed by payment type. If this file were to be amended each time a payment was made, then it would be easy to obtain a summary of the payments by type merely by specifying the payment type to an enquiry program. Of course, all of this processing could be carried out using any form of file system. The use of a relational database, which only allows files to be accessed by pre-specified keys, makes such tasks much easier.

Left: Richard Pick.
Below: Pick OS structure.



MS-DOS and its rivals

- For system implementors the ease with which drivers can be added is the best thing about MS-DOS. As one of them put it to me: "You need a lot less support: which is just as well, because you get a lot less support."
- For users, the most important thing about MS-DOS is the wealth of available software. Because of the runaway sales of the IBM PC, the MS-DOS repertoire is considerably greater than that for CP/M-86 and Concurrent CP/M. Much of the early popularity of MS-DOS was because of the way its RAM-based directories make it faster than CP/M-86 on small floppy-disc machines. Reportedly CP/M Plus and products like Concurrent CP/M Plus which are beginning to flow from it more than redress the balance.
- The Microsoft product continues to score over its Digital Research rivals with its extended facilities for recalling and editing the command line: long, incorrectly entered commands do not have to be retyped in full. It also has a really useful batch processor that works quickly, operates on all drives, and can take decisions — three points where CP/M's Submit falls down.
- An important secondary consideration is the superior error handling of MS-DOS. CP/M has come in for some rather unfair criticism in this respect. Kildall provided the notorious "BDOS error on P" as the basic minimum, and left it to system implementors to improve on it in the BIOS. Few did. MS-DOS puts rather more extensive error handling into the DOS, guaranteeing that it is consistent across different implementations.
- The piecemeal enhancements to be added to MS-DOS 2 are now starting to appear. The first is Microsoft Windows, a resident system process that allows you to run more than one program simultaneously. Each program can be allocated a part of the screen to itself, and data can be passed between programs.
- As it stands, Microsoft Windows is not a full multi-tasking system because it requires all its programs to be in RAM. Windows has no mechanism for juggling RAM and backing store, as in Unix, to accommodate an unlimited number of programs. Without it Windows is a limited, front-end product aimed mostly at reassuring OEM customers that Microsoft is holding its own against the Lisa, Visi On and Concurrent CP/M competition. The OEMs are responding enthusiastically, though IBM is still non-commital about the product.

Xenix-based software development. That version is not yet with us. In fact the latest news is that MS-DOS 3 will not appear at all, at least not under that name. Enhancements are to be added piecemeal.

Version 2 of MS-DOS is a brave attempt to bridge the gap between the bought-in Seattle Computers 1.25 version, and full-blown Xenix. The most immediately noticeable difference from its 1.25 and CP/M predecessors is the hierarchical directory that treats directories as files that can also include other directories, and so on more or less *ad infinitum*.

Hard-disc boon

To what extent this is an improvement is not easy to say. The approach confers little advantage for the limited backing-store capacity of a floppy-disc system, but users have found it a boon in the hard-disc environment. Even so, the user unbiased towards Unix is likely to find CP/M's straightforward layered division of a Winchester drive into user areas in many ways easier for managing a large number of files.

Where disc space is limited there is some argument for the byte granularity of the MS-DOS filing system. Instead of blocking files on to the disc in allocation units typically of 2K — but as much as 16K on some Winchester systems — MS-DOS can be implemented to write no more than the exact number of bytes. In CP/M even a small file can seize a sizeable chunk of the disc.

The internal redesign that made this possible was the way the BIOS and I/O handling was changed to work through device drivers that can be thought of as separate from the operating system. A device driver is a software routine that acts as a go-between in the transactions the operating system must have with hardware devices like printers, console and disc drives. The wildly various and sometimes awkward requirements of these peripherals are translated by device drivers into formal, orderly requests that the operating system can understand. As most device drivers are bi-directional, the translation process also works the other way round.

As with the earlier version, and with CP/M, the operating system proper is isolated from the hardware by a 15K chunk of hardware-dependent assembler code, the BIOS. Traditionally the device drivers are embedded in this code, which is supplied by the OEM, like the cogs and wheels in a clock.

The 2.0 BIOS is quite different. The jump table that was the traditional CP/M-style entry point is now replaced by a linked list of devices that can be reconfigured at will — even, in simple cases, by the user. On booting up, MS-DOS 2.0 reads a text file called Config.Sys, which defines the drivers to be laoded into RAM. Initialisation code is loaded, executed and then overwritten. It is a useful technique for conserving memory by making sure that routines only needed at boot-time do not outstay their welcome.

Memory conservation is still an issue, despite the ability of the 8086 family of chips to address a megabyte of RAM. Competition encourages OEMs to squeeze production costs, and most MS-DOS machines arrive in the market-place with no more than 128K of RAM. Compare the 15K of MS-DOS BIOS with the 2K BIOS for CP/M-80. Floating device drivers may further increase this disparity for they are always more demanding of space than embedded drivers.

Unix ideas

The drivers of MS-DOS 2 each define two entry points, called the Strategy and Interrupt routines, in another technique borrowed from Unix. The idea is that processes calling the drivers must not be allowed to hog the resources. So the first call from the process registers a request for the port, drive or whatever, and immediately relinquishes control. The Interrupt routine then has the job of dealing fairly with the queued requests and flagging them as completed when they are finished.

In MS-DOS 2.0, however, the idea is there only as a shadow of the multi-tasking I/O handling the technique implies. The Interrupt and Strategy routines are simply welded together, the one calling the other with no chance for other processes to break in.

But the data handling associated with this method is only partially implemented. Instead of streaming data through the CPU's accumulator in the usual way, the data has to be buffered in RAM in packets. Each packet must be keyed with headers so that the Interrupt routine knows what to do with it. MS-DOS 2.0 does implement this packet passing; however, since it allows only a single request to be pending at any time the exercise does not turn out to be particularly productive.

In the Unix tradition, two types of device are supported: character and block. Character devices like consoles, modems and printers, will pass their data into and out of the packet one byte at a time. Block devices, notably disc drives, move their data in chunks that are allowed to vary in size so that exact numbers of bytes can be accommodated.

The chosen one

When IBM adopted MS-DOS for the PC it became the premier 16-bit operating system. Chris Bidmead wonders whether its success is well deserved.

MUCH HYPE and rumour surrounds the origin of MS-DOS. This short account comes direct from the protagonists: from Bill Gates of Microsoft, which got the IBM contract to produce an operating system for the IBM PC; and from Gary Kildall of Digital Research, which didn't.

IBM wanted a version of CP/M to run on its new baby. According to Kildall Bill Gates was approached first because IBM knew so little about the micro market it thought CP/M came from him, but according to Gates it was because Microsoft had implemented more CP/M systems than anybody, including Digital Research.

Gates sent IBM to Kildall, because he understood that a launch of CP/M-86 was imminent. But, says Gates, Gary Kildall was out flying his plane the day the gentlemen from IBM arrived. They returned to Bill Gates and said the contract was his if he could make the deadline.

Gary Kildall is not pleased with this version of the story. He was not out joy-riding that day, as the Microsoft faction likes to imply, but had flown off to visit some clients. In any case, there were some legal difficulties to be cleared up before he could talk to IBM.

Wary from past experience, IBM was insisting that a waiver be signed to preclude any litigation arising out of the discussions. If an idea they discussed were to turn up later in an IBM product, IBM did not want an expensive legal squabble about who thought of it first. That was the intent, but its effect was far wider, and Kildall's lawyers had warned him that, technically speaking, IBM might walk away from the meeting virtually owning CP/M.

Agreement

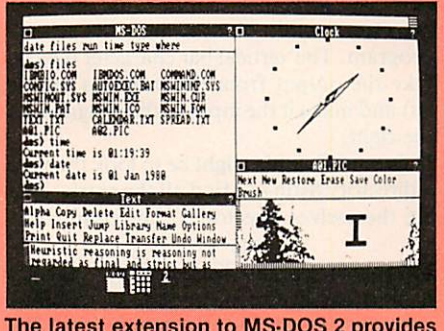
Bill Gates either had better lawyers, or was less finicky about the preconditions. He talked to IBM, and the result was an agreement to produce a 16-bit operating system for the IBM PC in an uncomfortably short time. History does not disclose the financial terms of the contract, but IBM watchers have no reason to believe they were generous.

But by this time Bill Gates had one card up his sleeve. He knew of a company in his home town of Seattle that made 16-bit processor boards and which was so tired of waiting for Digital Research's CP/M-86 that it had written its own.

So it was that the original author of MS-DOS was not Microsoft but Seattle Computer Products. It was always intended as a stop-gap meausure, and as such it was exactly what Bill Gates needed while he geared up his team to meet his sparkling new contract with IBM.

That release, version 1.25, is now replaced by version 2. The update is characterised by a style that owes a great deal to Unix, with a treed directory, a pseudo-pipe facility, a handful of filter-style utilities, and the peripherals-as-files philosophy.

Bill Gates of Microsoft.



The latest extension to MS-DOS 2 provides user-definable windows.

MS-DOS in either version is generally agreed to be easier to use than the colourless CP/M-86 that eventually emerged from Digital Research. Properly implemented — and there are some notorious exceptions — MS-DOS has several advantages for the user over CP/M-86, including disc speed and ease-of-command line editing.

But CP/M-86 itself was only a vamp-till-ready while Concurrent CP/M was being put together behind the scenes. Midway through 1983 Concurrent CP/M made its entrance, embodied in the utilitarian hardware of the IBM PC.

Faced with the threat of this efficient, usable, and above all, available offering from Digital Research, Microsoft first said that users did not need multi-tasking. If they did there was always Xenix, Microsoft's own slightly more polished version of Bell Labs' original Unix. The fact that the progress of Xenix in the commercial word had not, up to then, been very impressive would seem to reinforce the point, though Microsoft naturally did not say so.

Interruptions

But the announcement went on to say that "when the market was ready" a subsequent version of MS-DOS, would offer a "hold" feature to let users suspend a running process to go off and do other tasks. On returning to the initial process the machine state would be recalled and everything would resume as if there had been no interruption. Bill Gates claimed that for single users this was much more useful than to have processes churning away in the background.

We will never know what went on in the mind of IBM, but it appears that the corporation was impressed by Digital Research's achievements with Concurrent CP/M, and may well have gone back to its own supplier with some politely phrased questions. Whatever the cause, there followed a slight rewrite of history, in which Microsoft announced that true multi-tasking, along with a networking capability, was always intended to form part of the kernel of MS-DOS version 3, due early in 1984.

The fact of MS-DOS 3 being written in C was supposed to be speeding it to the market-place, for one of Microsoft's proud boasts is the superior productivity of its

<name1> is taken to be a sub-directory of the current directory, which in turn holds a file called <name2>. The single name <name1> refers to a non-directory file in the current directory.

A feature called Linking allows the same non-directory file to turn up in more than one directory, and even under different names. This is possible because files do not actually exist within any particular directory. The directory entry is no more than a pointer to the information actually describing the file.

The feature can be used, to quote a real-life example, in coping with the logistics of maintaining different versions of the source code for a software product. The software house of Southdata develops its Superfile database under Idris, a reverse-engineered Unix from Real Time Systems. Southdata covers the variety of operating systems on which its product must run by storing the Superfile source code in directories called MS-DOS, CP/M-86, CP/M-80 and so forth.

To make sure that modifications made to one version of Superfile are automatically applied to others where appropriate, the source files that appear in the separate directories are actually one and the same file. Linked to the various directories, and suitably dotted with compiler conditionals to match each target operating system, the master file is able to cope with revisions from all fronts.

With special files, Unix introduced a genuine innovation to computing which was subsequently adopted by MS-DOS 2. File-name pointers can be connected to I/O device drivers, enabling them to be read and written to, where appropriate, just like an ordinary disc file. Special files connect the directory up to communication lines, discs, peripherals, and even to raw memory.

When I/O devices are handled like this, file and device names have the same syntax and meaning, so a program expecting a file name as a parameter can be passed a device name. This arrangement also allows special files to be given the same access protection as regular files.

The root directory is always kept on the same device, often a built-in Winchester disc. By a process known as Mounting, additional devices such as floppies can become temporary branches of the file-system tree. The Mount system request is given with two arguments: the name of an existing ordinary file kept in the root directory specially for the purpose, followed by the name of a special file that is in fact a device with an independent file system containing its own treed directory.

Executing the Mount makes all subsequent references to the ordinary file refer instead to the root directory of the Mounted file system. In effect, the Mount expands the ordinary file into a whole new sub-tree. This approach will seem fussy to users of micro systems where the repertoire of mass-storage devices is decided when the system is generated, and the equivalent of Mounting consists at the most of hitting Control-C, as under CP/M. Its advantage is that it leaves a Unix machine open-ended for future hardware expansion.

Unix protects its files by tagging each one with a set of 10 mode bits, the values of which are controlled by the user who creates the file. One bit is set if the file is a directory, and three triads of three bits each indicate Read, Write and Execute permission for the local user, the user's group and for all users in general.

Listing the directory in long form will show the values held in this bit field. For the purposes of restoring forgotten passwords, backing up, and other system maintenance where the protection system would be a nuisance, Unix provides for a super-user who overrides the usual file-access constraints.

Redirection

Unix allows I/O redirection and piping. The standard assumption of programs running under Unix is that input will come from the user's keyboard and output will go to the console screen. Redirection allows this assumption to be altered at the last moment, from the command line immediately prior to execution. Left and right arrows are used to indicate the device and file to be used for input and output.

Pipes are an extension of the same idea. By naming a pair of executable files in the command line with a vertical bar character between them, the output from the first program can be directed into the second program. The vertical bar character means: take the output from the program on the left and make it the input to the program on the right.

One use for this might be to look through a directory listing to find all the entries that are themselves directories. The command

```
ls -1
```

will produce a long listing, where each file name is accompanied by a readable presentation of the protection bits. The first bit is displayed as a d if the file is a directory, and lines like this can be selected by using the pattern-recognition program Grep with the parameter ^d, which means: look for a d as the first character on the left-hand edge.

The command line to do this will look like:

```
ls -1 > grep '^d'
```

Because Unix is a true multi-tasking system the programs will run simultaneously. The pseudo-pipes of MS-DOS 2, and the Microshell CP/M enhancement, are emulated by the creation of a temporary file to hold the output of the first file until the second begins its run.

File interlocks

Unix makes no distinctions at system level between random and sequential file operations. No logical record size is imposed, unlike the 128-byte records for CP/M. As you might expect on a multi-user system, there are internal interlocks to prevent users deleting each other's open files and creating files with the same name in the same directory.

The level of file and record interlocking provided by MP/M-II, for example, was rejected by the Unix designers as being unnecessary and insufficient. Consequently raw Unix occasionally produces un-scheduled revision of files that are simultaneously written to by more than one user.

This does not mean that Unix is totally unsuitable for business use. Modern versions of Unix, like Uniplus + from Root Computers Ltd, include record-locking facilities. On systems without them, applications packages will obviously have to supply their own elaborate checking mechanisms.

For an operating system of its size and capability, Unix is very portable, thanks to its being written in a high-level language. Customised shells will go a long way to meet the non-scientific, non-academic market, but the more you cover Unix the slower it gets. Even ordinary single-user versions still usually contain the multi-user kernel, which spends CPU resources in unnecessary housekeeping, looking out for non-existent other users. Unix has been called "The octopus in your tank".

Not enough Unix software is yet available to compete with CP/M and MS-DOS in the field of business administration, although this may change quickly. Microsoft is already embracing Unix in the form of Xenix, and now Digital Research has changed its tack with a dramatic recent announcement of applications software support for Unix.

Despite Unix's built-in facilities for generating and maintaining documentation, or perhaps because of them, the manuals are over-blown, inconsistent in tone, and in need of drastic editing. The Xenix documentation is little better, though it does offer some improvement in the indexing and general organisation.

Unix features

- A treed directory system with demountable volumes.
- Compatible file, device and inter-process I/O.
- The ability to run several processes at once.
- Shells that can be chosen individually by users, even on a multi-user system.
- A huge range of utilities and OS functions, including a dozen languages.

(continued from previous page)
and the sanctuary of Bells Labs. The computing power it needed was not generally available beyond the narrow orbit of minicomputers built by DEC and Data General, who were too busy gathering revenue on their own operating systems to want to alert their customers to alternatives. AT&T was blocked from making a commercial go of Unix by U.S. anti-trust legislation. Even as recently as 1982 there were no more than 20,000 Unix-based computer systems in the U.S.

The number rose by five times in 1983. This leap in popularity came as no surprise to observers of the college scene: with benign commercial foresight Bell Labs had been sowing seeds for the future with cheap educational licences. Current estimates reported in *The Economist* are that the Unix user base will grow to half a million by the end of 1985.

As a general-purpose, multi-user interactive operating system Unix offers a collection of features not usually found even in larger operating systems. You can think of Unix as being in three layers. At the centre is the kernel of code that directly accesses the hardware. It is equivalent to CP/M's BIOS, the section that has to be adapted for different hardware environments. The kernel remains in core all the time that Unix is running, controlling the file handling, multi-tasking and I/O.

Wrapped around the kernel is the shell, a glorified command-line interpreter that also combines the capability of executing batch files, rather like CP/M's Submit. Although two shells are supplied as standard with most versions of Unix, it was the intention of the designers that users or OEMs should be able to write their own easily.

Many implementations, like the Fortune 32:16 do take advantage of this. Three shells come with Microsoft's Xenix, a derivative of Bell Labs' Unix version 7 with several additional extensions from the University of California, Berkeley.

Standard shells

The standard shells are very powerful, allowing While and For loop constructions, parameter substitution, and file-name expansion from wild cards. And you do not have to be a C programmer to change the way that the shells work. Non-programmers can write what are called "shell scripts" in plain text to run under either the Bourne shell or the Berkeley C-shell, whose syntax is a simplification of C's.

Outside the shell lie the utilities. A huge variety of them come as standard with most versions. C itself is included, together with a rich selection of aids for software developers. Although they are all regarded as part of the system, some Unix implementations allow you to buy subsets of the utilities. It seems sensible to leave the business world in ignorance of the accumulation of ingenious and sometimes miraculous aids for programmers that make up a large proportion of the utilities, but this sacrifices the designers' fundamental idea that any Unix system should be self-supporting.

The most important role of any operating system is to provide a method of handling files. The Unix user sees files as being of three kinds: ordinary disc files, directories and special files. Ordinary files include text files and binary, executable programs. They are created with no special structuring, except that the terminator of text lines is traditionally regarded as a single character — the Newline character — although it may in fact consist of a Carriage Return plus a Line Feed.

Directories behave exactly like ordinary files except that they cannot be written on by ordinary programs; it is the system itself that controls the directory contents. The system maintains several directories for its own use, the main one of which is called the root directory. All the other directories are files in the root directory, and any file in the system can be found by tracing a path through the branching chain of directories. Typically a special system directory called Bin contains all the system command programs, although a program does not need to reside in this directory to be executed.

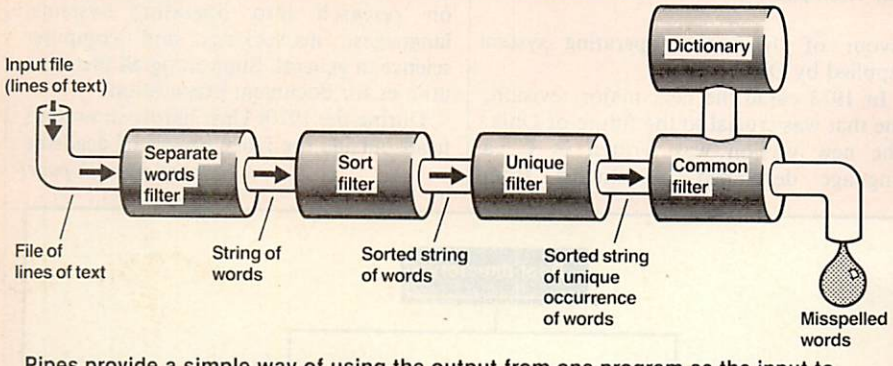
Name sequences

Files names have 14 or fewer characters. Files outside the current directory can be evoked by giving the full path name, that is to say a sequence of directory names separated by / characters and ending in a file name. If the sequence begins with a slash, the search begins in the root directory. For example, specifying

/<name1>/<name2>/<name3>

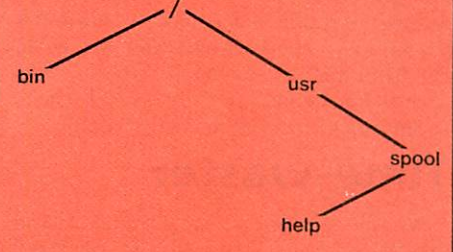
causes the system to search the root for directory <name1>, then to search <name1> for <name2>, finally to find <name3> in <name2>. The name / refers to the root itself.

Any name not beginning with / starts the search in the current directory. If it is a path name, like <name1> / <name2>, then



Pipes provide a simple way of using the output from one program as the input to another. Here a dictionary is created from a text file by several small general programs linked by pipes.

Hierarchical file structure.



Root directory listing.

```
total 117
-rw-r--r-- 2 bin          112 Feb 12 18:43 .profile
drwxrwxrwx 3 root         128 Jul 26  1983 b
drwxrwxr-x 2 root         896 Dec 16 02:37 bin
-rw-rw-r-- 1 root           0 Feb 13 09:37 demo
drwxr-xr-x 2 root        1328 Feb 13 02:27 dev
drwxrwxr-x 4 root        1088 Feb 13 09:12 etc
drwxrwxrwx 2 root          32 Mar  8  1983 f
drwxrwxrwx 2 bin           32 Oct  6  1982 h
drwxrwxrwx 2 root        2048 Mar  8  1983 lost+found
drwxrwxrwx10 root         176 Dec 16 03:05 m
drwxrwxr-x 2 root          48 Jul 18  1983 man
drwxr-xr-x 2 bin           80 Aug  5  1983 sa
drwxrwxrwx 2 bin          192 Feb 13 02:27 tmp
drwxrwxr-x26 bin          416 Feb 12 18:57 u
-r--r--r-- 2 bin       100412 Jun 30  1983 unix
drwxrwxr-x11 root         192 Aug 21 20:32 usr
drwxrwxr-x 2 root          80 Feb 13 09:36 util
```

One level down from the root is the USR sub-directory.

```
total 10
drwxrwxr-x 2 root        1152 Feb 12 14:29 bin
-rw-rw-r-- 1 root           0 Feb 13 09:48 demo
drwxrwxrwx 2 bin          224 Sep 20 07:55 games
drwxrwxr-x 2 bin          160 Jul  6  1983 help
drwxrwxr-x 3 root         480 Jul 22  1983 include
drwxrwxr-x 5 bin          336 Aug 24 10:26 lib
drwxrwxr-x 6 root          96 Jul  6  1983 man
drwxrwxr-x 4 bin           64 Jul  6  1983 spool
drwxrwxrwx 2 bin           64 Feb  2 11:45 tmp
drwxrwxr-x 2 bin          432 Jul  6  1983 ucb
```

The octopus in your tank

After years in the hands of researchers Unix is to appear as a commercially backed operating system on micros. Chris Bidmead assesses its chances.

ON JANUARY 12 this year IBM made it official. Unix goes on to the IBM PC with the company's blessing, and so the rapidly snowballing product of the Bell Labs boffins has finally arrived officially on the micro market. Interestingly, IBM stock prices dipped at the news, Wall Street assuming that AT&T, the multi-national giant of which Bells Labs is the research department, would now hold IBM in the palm of its hand. It just shows how little Wall Street knows about operating systems, and about IBM.

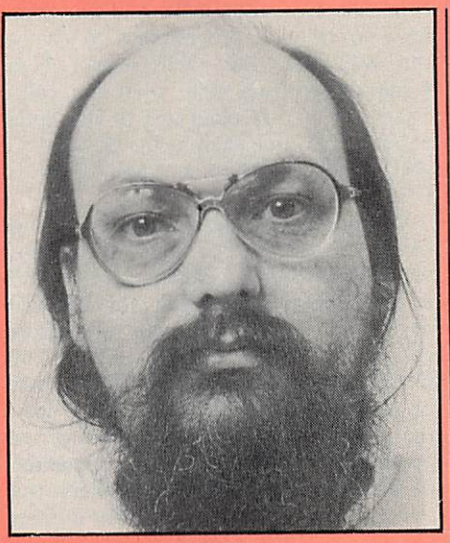
In a recent series on Unix, *Byte* magazine recounts how the earliest version of the operating system was derived from an ambitious and sprawling project called Multics, a time-sharing development in which the Massachusetts Institute of Technology, Bell Laboratories and General Electric all had a hand. By 1969 Multics seemed to be getting nowhere slowly, and Bell Labs withdrew its support. The news came as a blow to Bell Labs computer scientist Ken Thompson. While the rest of the project was turning sour, his own Space Travel game was coming along nicely on one of the Multics time-sharing terminals.

The only alternative hardware that Thompson had to hand at Bell Labs was a neglected PDP-7. Its operating system offered little support for program development, so he rolled up his sleeves and got stuck into PDP-7 assembler to construct a rudimentary filing system and a few utilities. The improvisation was a far cry from the monumental Multics, and since there was nothing "multi" about it, Thompson christened his baby Unix.

Time-waster

At this point the Unix/Space Travel project was still just another of those unofficial machine-hogging time-wasters. It became official when together they were able to offer some simple word-processing facilities, and other departments began to see some value in it for them.

In February 1971, with the help of some official funding, the operation was resited on a PDP-11 in a radical revision inspired by Ritchie from the previous year's experience. PDP-11s sprang up in other departments, and users chose Unix in favour of the native operating system supplied by DEC.



Ken Thompson of Bell Labs.

In 1973 came the next major revision, one that was crucial to the future of Unix. The new version was written in C, a language developed by Ritchie from BCPL; it was designed to replace B, which was a bare-bones rejig of BCPL knocked up by Thompson.

Unix and its utilities now comprised over 300,000 lines of C source code, an effort that remains the most ambitious project ever written in the language. The virtual-memory techniques which the system employed required only 53K of the system to be resident in core memory, which was just as well since there was only 122K of RAM in the PDP-11s.

Between 1971 and 1974 over 100 Unix installations went into service. They were generally smaller than the full-blown version, and mostly engaged in jobs like preparing and formatting patent applications, dealing with fault reports on the Bell telephone system, and recording and checking telephone service orders. At the central installation the accent remained on research into operating systems, languages, networking, and computer science in general. Supporting all this were utilities for document preparation.

During the 1970s Unix hardly showed its head outside the ivory towers of academe

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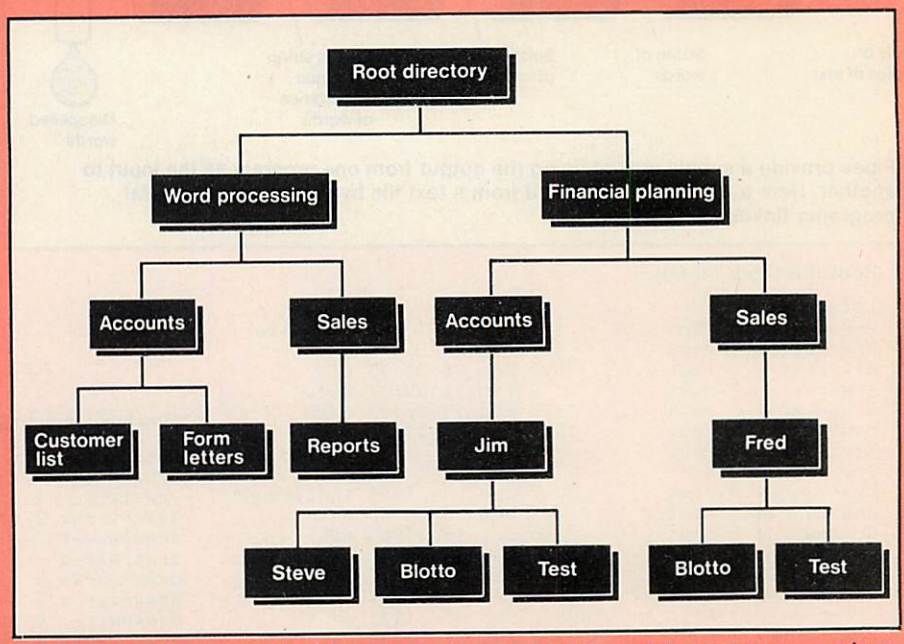

With the tree-structured directory you can have several files of the same name as long as they are reached by different paths.

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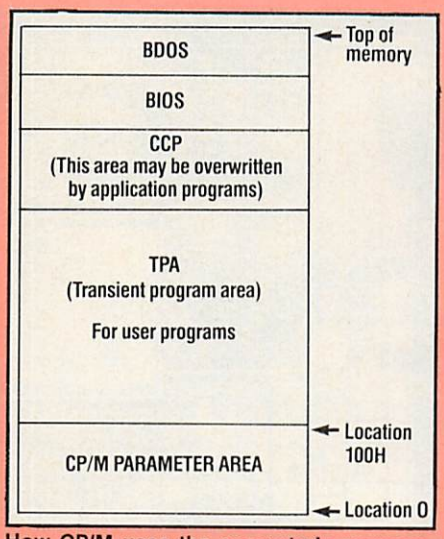

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For. Software portability. Good range of programmer's tools. Well established in higher education. Widely available.
Against. Limited range of business software. Supports Pascal and Fortran but few other languages.

Future. *The p-System is very strong in education and so unlikely to disappear rapidly. Its standing in the business community is much weaker, but the way it is implemented, compiling down to an intermediate code, makes it suitable for running under another OS, Unix being the most attractive choice. So with its large base of technical and often free public-domain software, the p-System will live on.*

Microcomputer operating systems
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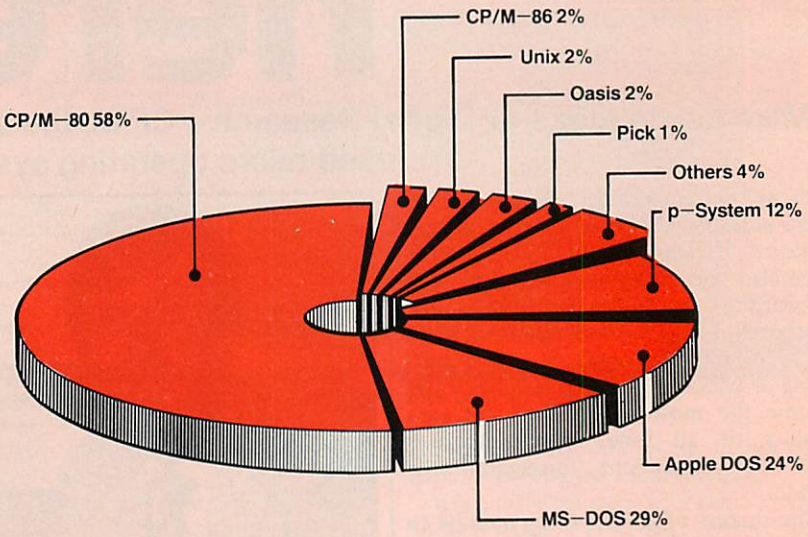

Source: International resource development Inc.
Pie chart shows percentage of computers running each operating system. Total is greater than 100% because of computers used with more than one OS.

Pick

Originally a mini OS, now dropping down on to micros for both single and multi-users. Pick integrates OS with data-management and query system. It is supposed to be easy to use. System developers have adopted Pick to create vertical-market packages quickly. At present available mainly on 68000-based systems; an IBM PC version is just available.

For. Built-in database. Virtual-memory management. Easy for user. Great for system developers. Fast.
Against. New to micros. Available on only a few machines.

Future. *Pick is unlikely to ever become a mass-market OS, but it will gain increasing acceptance as vertical-market packages emerge and as users of larger computers begin to realise how important the proper control of access to data is in multi-user systems. It is likely to appeal to large corporations where the DP professionals will recognise Pick's advantages.*

Oasis

Multi-user operating system available in eight-bit and 16-bit versions. Oasis has tended to be available only on rather obscure machines, and is only now coming out into the light of day. Proponents say it rivals Unix in facilities but is easier for the end-user. C, Cobol and compiled Basic are currently supported.

For. Easy to use. Robust. Good development utilities and range of file types. Good security features.
Against. Less software than rivals. May be too late.

Future. *Oasis has enthusiastic supporters in the business community but the arrival of the 16-bit version was long held up by contractual disputes. Its future depends on word-of-mouth reputation turning into solid support from major hardware manufacturers, who mostly seem to be going down the Unix road.*

BOS

Business-orientated multi-user operating system linked to Microcobol, originally developed by U.K. software house CAP with government aid. Cobol has advantages over Basic for develoing multi-user software. Microcobol running under BOS compiles down to a very portable intermediate code along p-System lines.

For. Highly portable across different machines, ISAM file support. Multi-user system for micros that actually works.
Against. Limited software base. Software has to be written in specific version of Cobol.

Future. *BOS is still a credible choice for multi-user systems as the competition is still weak in the business sector and application software running under BOS has a good reputation for reliability. But the very specific tie to one proprietary dialect of Cobol makes BOS's long-term future look gloomy.*

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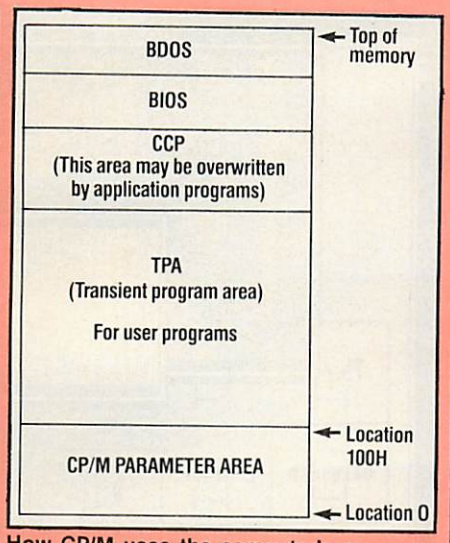

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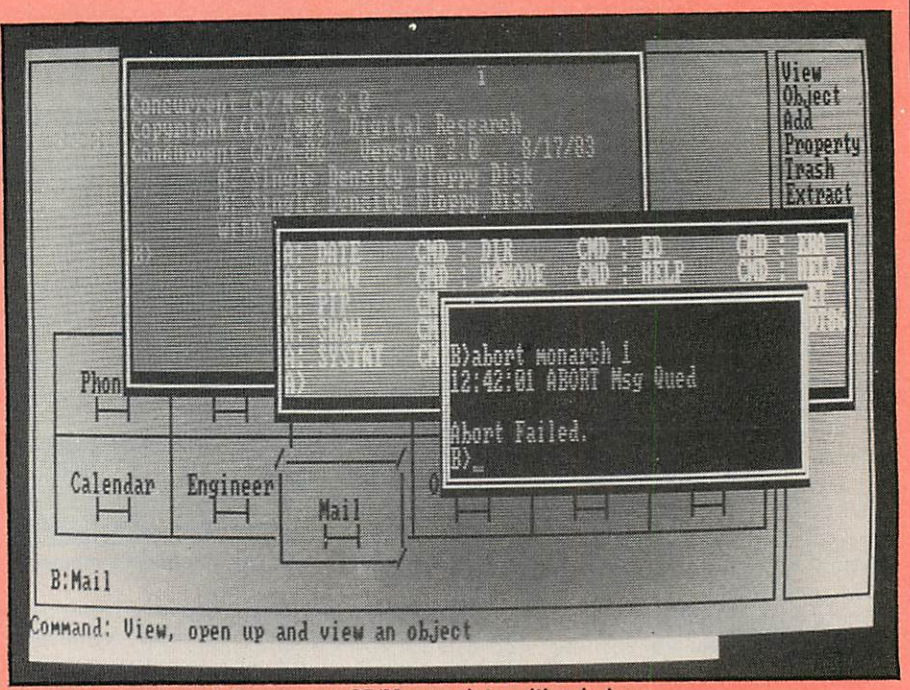
Last year, Digital Research released a much enhanced version, originally labelled CP/M 3.0 but later renamed CP/M Plus. This release was not intended as a replacement for 2.2, but as a new product designed to take advantage of the larger RAM and disc capacities becoming available.

CP/M Plus has many new features, some of which answer specific complaints from users, while others pay passing tribute to more sophisticated operating systems such as Unix. Thus you have a limited form of I/O redirection, a simple tree structure for directories, and a password scheme that works at both disc and file levels. In response to a barrage of criticism about unfriendliness, Digital Research has implemented a rudimentary Help system.

Perhaps the most interesting feature of CP/M Plus is its support for Resident System Extensions. These user-written modules are intended to enhance and extend the operating system in a way that is specific to the user's application. They can be loaded into RAM, where they are co-resident with the application software and communicate with it in much the same way as does CP/M itself.

CP/M undoubtedly dominates the eight-bit world, but move into the domain of 16-bit processors and it is a different story. Here the senior member of the family is CP/M-86, which is currently battling against Microsoft's MS-DOS for the leadership of the market. At the moment it is looking more and more likely that Microsoft will win.



The latest version of Concurrent CP/M complete with windows.

CP/M-86 is more or less a straight conversion of CP/M 2.2 to the 8088 and 8086 processors. It looks like eight-bit CP/M — or CP/M-80, as Digital Research is now calling it — apart from a few new features such as track buffering and background printing. MS-DOS, on the other hand, was designed for 16-bit chips.

It is a different story with Digital's other 16-bit offering, CP/M-68K. This product is a complete rewrite for the Motorola 68000 chip — hence the name. It is also the first of the CP/M operating system to be written in

(continued on next page)

CP/M commands

ASM — Invoke CP/M assembler; converts an assembly-language source program to Intel hex format
DDT — Invoke the Dynamic Debugging Tool; DDT is used to trace program execution, examine the contents of files, and incorporate low-volume patches into programs
DIR — Display a disc directory
DUMP — Display the contents of a file in hex
ED — Invoke the CP/M line editor
ERA — Delete a file or a group of files
LOAD — Convert a hex-format object file, as outpout from ASM, into an executable program
MOVCPM — Reconfigure and relocate CP/M for a different memory size
PIP — Multi-purpose file-transfer utility; Pip may be used to copy files, combine files, and transfer files between peripherals, for example from a modem to the screen
REN — Rename a file
SAVE — Copy the contents of RAM, or part thereof to a disc file
STAT — A multi-purpose command whose functions include: report free space on disc; report sizes of files; set read-only flags; set file attributes, report characteristics of disc drives; report and alter assignment of peripherals
SUBMIT — Invoke batch processing; CP/M will take its subsequent commands from a specified file, with optional parameter substitution
SYSGEN — Copy CP/M from the operating system tracks of a disc to those of a second disc
TYPE — Display the contents of a text file on the screen
USER — Change the current user number
XSUB — Used withing batch processing — see Submit — to direct programs to accept input from the batch file rather than the keyboard

The following commands are specific to CP/M Plus:

COPSYS — Similar to Sysgen
DATE — Set or display the current time and data
DEVICE — Assign logical devices to physical ports; set device attributes
DIRSYS — Like Dir, but permits display of system files
GENCOM — Create a user-program with an attached Resident System Extension
GET — Redirect keyboard input to come from a disc file
HELP — Display CP/M operating instructions
HEXCOM — Convert an object program into an executable program file; see also Mac
INITDIR — Initialise time and date stamping in the directory
LIB — Invoke the library-maintenance program
LINK — Combine relocatable program modules into an executable program file
MAC — Invoke the macro-assembler; converts assembler program into object code
PATCH — Install a patch in CP/M or a program
PUT — Redirect console or printer output to a disc file
RMAC — Invoke the relocatable macro assembler; converts assembler-language source programs into relocatable object modules
SET — Set disc labels, file attributes, data and time stamps and password protection
SETDEF — Set system options, including a directory-searching path
SHOW — Similar to Stat
SID — Invoke the symbolic debugging utility
XREF — Invoke the assembly-language cross-reference program

Kildall was here

Mike Lewis looks at Digital Research's CP/M, the archetypal and still most widely used micro operating system.

EVEN BY the remarkable standards of the micro industry, CP/M is an extraordinary product. It started life as a hastily assembled operating system that was awkward to use, scantily documented, and only barely did the job it set out to do. It did not even have the benefit of skilful marketing or packaging. Yet in 10 years it has become the most widely used software product of all time, with well over 1,000,000 installations throughout the world.

The success of CP/M owes nothing to technical excellence and everything to market forces. It is an operating system that lives in a 1960s world of punched paper tape and hard-copy Teletypes. It is the only OS designed to make a 25Mbyte Winchester perform like an 8in. floppy. And its reputation for enigmatic messages is so well established that in some circles the term BDOS Error is synonymous with everything that is mysterious and obscure.

So how can a million CP/M users be wrong? CP/M hit the big time because it was able to overcome one of the biggest problems facing the early microcomputer industry. It provided the means of transporting application programs from one manufacturer's hardware to another. This fact alone made CP/M into one of the two computer products that, literally, started in a shed and went on to make their inventors into millionaires.

Garden shed

In the case of CP/M, the shed was a children's playhouse in the garden of Gary Kildall's house in the town of Pacific Grove, at the northern tip of California's Monterey Peninsula. In the early 1970s, Kildall was teaching computer science at the Naval Postgraduate School in Monterey. He was also working as a consultant for the semiconductor firm Intel, where he was writing a compiler for the PL/M language.

One of Kildall's garden shed projects was to try to hook up an early floppy-disc drive to Intel's 8008-based Intellec development system, which was one of the world's first real microcomputers. With some help from his friend John Torode, who went on to found Digital Microsystems, he wired up a home-made disc controller, then knocked

Gary Kildall, inventor of CP/M.

up a simple control program. This was the first version of CP/M. It was written mainly in PL/M, was loaded via paper tape, and it worked.

Kildall offered CP/M to his bosses at Intel but, in what must have been the greatest missed opportunity in computing history, they turned it down. So Kildall starting selling it in ones and twos to computer enthusiasts, advertising it for $70 a time in magazines like *Dr Dobbs Journal.*

But it was not until computer manufacturers began to approach him for licences that Kildall started rethinking the structure of CP/M. He decided to recode parts of it, placing all the hardware-dependent features in a single module which he called the Basic Input/Output System — or BIOS as it is still known. The main part of the system would thus present a uniform and consistent interface to the programmer, who would not need to know anything about the specific configuration in use.

This was the making of CP/M. Not only was it now much easier to transport the system itself to new computers, it also enabled application programs to run on a whole range of different micros. Computer manufacturers bought it because it was readily available off the shelf. Software houses wrote programs for it because they were assured of a larger market for their products. And end-users opted for it because of the wide choice of software that was quickly becoming available for it.

In 1976, Kildall decided to devote himself full-time to developing and marketing CP/M. He stayed in the garden shed for another year, then incorporated his company as Digital Research and moved to a proper office. Today, Digital Research is the largest employer in Pacific Grove, and CP/M has developed into a whole family of operating systems.

The idea of CP/M as a family rather than as a single operating system is one that should be kept firmly in mind. The various members of the family may look similar to the casual user, but they are very much different products and they vary a lot both in features and quality.

The first CP/M to be sold in commercial quantitites was version 1.4. Although obsolete, this early release is still giving yeoman service in computer installations around the world. In a corner of my office, we have an ancient Microstar computer that we only use as a last-ditch standby. This venerable machine only supports CP/M 1.4, but that does not prevent us from running WordStar, dBase II and Microsoft Basic on it — although some recent versions of these products do require later releases of CP/M.

Awkward

Version 1.4 of CP/M was designed around the IBM 8in. single-sided, single-density floppy disc. It was theoretically possible to adapt the BIOS for higher-density discs, but it was awkward to do so. Our Microstar has double-sided drives, so the manufacturer implemented CP/M in such a way that each side appears as a separate drive, each with its own drive designation and directory.

Part of Digital Research's motivation for developing version 2.2 of CP/M was to overcome this and similar limitations in 1.4. Release 2.2 is the best known and most widely used implementation of CP/M. It gets round the problem of non-IBM floppies by storing all the required information about the disc configuration in a set of tables, making it far simpler to adapt to different disc formats and sizes.

CP/M 2.2 allows larger file and drive sizes than 1.4 — theoretically 8Mbyte each — and up to 16 logical drives, compared to four in 1.4 It also enables the user to flag files as read-only within the directory, to give a semi-permanent measure of protection against accidential erasure, and to divide the directory into a maximum of 16 compartments, or user areas.

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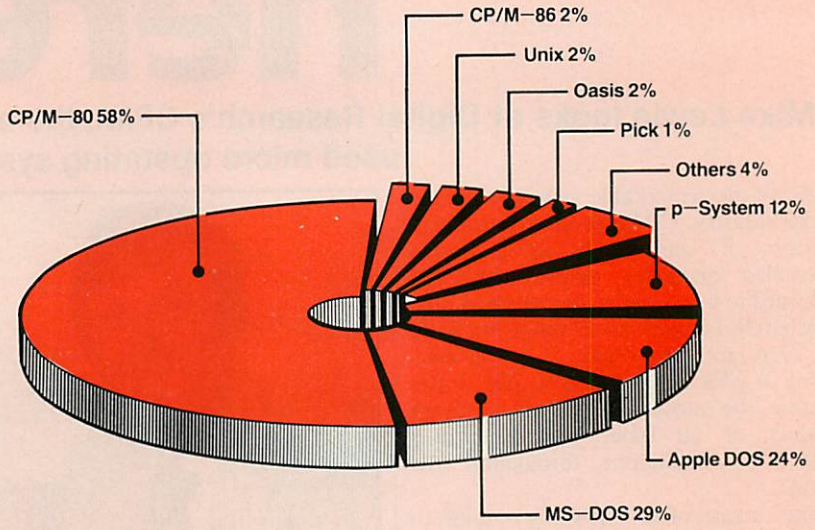
Microcomputer operating systems
Estimated 1983 usage



Source: International resource development Inc.
Pie chart shows percentage of computers running each operating system. Total is greater than 100% because of computers used with more than one OS.

Pick

Originally a mini OS, now dropping down on to micros for both single and multi-users. Pick integrates OS with data-management and query system. It is supposed to be easy to use. System developers have adopted Pick to create vertical-market packages quickly. At present available mainly on 68000-based systems; an IBM PC version is just available.

For. Built-in database. Virtual-memory management. Easy for user. Great for system developers. Fast.
Against. New to micros. Available on only a few machines.

Future. *Pick is unlikely to ever become a mass-market OS, but it will gain increasing acceptance as vertical-market packages emerge and as users of larger computers begin to realise how important the proper control of access to data is in multi-user systems. It is likely to appeal to large corporations where the DP professionals will recognise Pick's advantages.*

Oasis

Multi-user operating system available in eight-bit and 16-bit versions. Oasis has tended to be available only on rather obscure machines, and is only now coming out into the light of day. Proponents say it rivals Unix in facilities but is easier for the end-user. C, Cobol and compiled Basic are currently supported.

For. Easy to use. Robust. Good development utilities and range of file types. Good security features.
Against. Less software than rivals. May be too late.

Future. *Oasis has enthusiastic supporters in the business community but the arrival of the 16-bit version was long held up by contractual disputes. Its future depends on word-of-mouth reputation turning into solid support from major hardware manufacturers, who mostly seem to be going down the Unix road.*

BOS

Business-orientated multi-user operating system linked to Microcobol, originally developed by U.K. software house CAP with government aid. Cobol has advantages over Basic for develoing multi-user software. Microcobol running under BOS compiles down to a very portable intermediate code along p-System lines.

For. Highly portable across different machines, ISAM file support. Multi-user system for micros that actually works.
Against. Limited software base. Software has to be written in specific version of Cobol.

Future. *BOS is still a credible choice for multi-user systems as the competition is still weak in the business sector and application software running under BOS has a good reputation for reliability. But the very specific tie to one proprietary dialect of Cobol makes BOS's long-term future look gloomy.*

OS top 10 guide

CP/M-80

One of the original eight-bit operating systems, now a family of several compatible products known generically as CP/M-80. CP/M 2.2 is the most widely used current version. CP/M Plus has extra features including tree-structured directories and better help facilities. Personal CP/M is a new development intended for home computers. It has a friendlier user interface and is supplied on ROM.

For. Very large software base. Easy for manufacturers to get running on new machines.
Against. Crude. CP/M 2.2, with its notorious error messages, is hard for newcomers to use.

Future. *CP/M will probably survive much longer than many expect, as eight-bit machines are still fundamentally cheaper. Zilog's forthcoming chip offering both Personal CP/M in ROM and a Z-80 processor in the same 40-pin package should give eight-bit CP/M a new lease of life as an OS for home machines.*

MS-DOS

Known as PC-DOS on the IBM PC, MS-DOS is now running on most new 16-bit office systems and is developing into a family of compatible products. Xenix is the multi-user product, based on an officially licensed version of Unix. MSX-DOS is the forthcoming disc operating system for the Microsoft-inspired family of Japanese MSX eight-bit home machines.

For. Very large software base. Reasonable error messages. Tree-structured directories.
Against. Still unfriendly compared to integrated systems. Only runs on 8086 and 8088 machines.

Future. *Much depends on whether IBM stays with MS-DOS, but Microsoft has worked hard and succeeded in winning most other 16-bit manufacturers to its OS family. The Unix-like Xenix for multi-user systems and the file-compatible MSX for eight-bit home machines gives the MS-DOS family great strength across the range, though IBM seems to prefer Unix itself to Xenix.*

Apple DOS

The eight-bit Apple II machine range uses Apple DOS, which probably has the third largest software base after CP/M and MS-DOS. Prodos is a new, compatible product aimed at system developers rather than end-users.

For. Large software base. DOS itself occupies little memory.
Against. Limited to Apple and look-alikes. Rather crude. Needs improved user interface.

Future. *Like CP/M-80, Apple DOS will probably survive better than expected in some form as the OS for cheap eight-bit machines. Apple is planning new eight-bit models for the home and budget business sector, and is not likely to abandon the enormous DOS software base. Tied very closely to the way Apple develops.*

CP/M 16-bit

The 16-bit members of the CP/M family preserve a similar user interface to CP/M-80, but with many new facilities. CP/M-86 is straight rewrite for 8088 and 8086 machines; MP/M-86 is multi-user variant. Concurrent CP/M-86 provides multi-tasking for single users, and now has windows. CP/M-68K is for 68000-based machines and aims to compete against Unix.

For. Easy for the CP/M-80 user to get used to. Good range of software. Concurrent CP/M-86 is very powerful.
Against. Bad user interface. Concurrent version requires powerful hardware set-up.

Future. *Looking brighter now that Concurrent CP/M has arrived on the scene. Concurrency or multi-tasking lets the machine carry on with one task while continuing another on the screen. As hardware improves and office automation gets under way concurrency is likely to be what computer users will want.*

Unix

Multi-user minicomputer operating system now dropping down on to the more powerful micros. Unix supports multi-tasking as well as multiple terminals connected to a single system. It is well established among university and technical users and is beginning to look unstoppable with IBM, MS-DOS creator Microsoft and CP/M creator Digital Research all apparently accepting it as the main multi-user contender.

For. Provides great tools for programmers. Truly multi-tasking. Software is very portable.
Against. Little commercial software. Needs plenty of disc space. Only runs on 68000-based systems at present.

Future. *IBM's interest in Unix for the PC coupled to its present strength in academic and technical computing seem to assure it a strong future as improved hardware capable of doing it justice becomes available. Unix may be rather unwieldy for simple end-user tasks, and the real threat to it comes from the more user-friendly integrated systems.*

Integrated OSs

The radical philosophy about how computers can be made easy to use was first pioneered by Smalltalk. Distinctions between OS and application program disappear. A consistent multi-tasking environment allows users to control the system, often using a mouse to point to graphics symbols on the screen. Apple's Lisa and Macintosh machines, the ICL Perq and the Gavilan portable all use an integrated OS.

For. Easy to learn to use. No-fuss multi-tasking. Software is usually integrated.
Against. Requires powerful hardware. Can be slow. Software base small.

Future. *All the evidence indicates that this is the way things are going. If not in the next two years then in the next five, conventional operating systems will be overtaken in the market-place by integrated OSs — or more likely, they will evolve a similar face to present to the world. Mice and multiple on-screen windows are already being copied, though data integration and true multi-tasking will take longer.*

of the operating system is to allow the operator to communicate with the computer. At its very least, the OS has to provide some mechanism for the operator to specify which program is to be run next. This usually means accepting a command from the console, loading the required program into RAM, and passing control to it in an orderly and consistent way.

In fact, most systems provide much more sophisticated methods of running programs. Version 2 of MS-DOS is a good example, with its complex system of operator commands that is almost a programming language in its own right. Even CP/M's humble Submit command lets the operator run a pre-specified sequence of tasks without any manual intervention. Add to this the automatic execution of a commnd on powering up, and you can arrange things so that the operator never even needs to see the operating system.

The visible, operator-orientated part of the operating system is sometimes called the shell, as distinct from the inner kernel that forms the heart of the system. In CP/M, the shell is called the Console Command Processor, and it is recognised by the familiar prompt, A>. It usually has other responsibilities, like keeping the operator informed about such vital topics as the amount of free space remaining on a disc, and the existence of damaged or suspect blocks of data on the disc.

No agreement

Surprisingly, there seems to be no universal agreement on which functions rightly form part of the OS and which can safely be made the dominion of higher-level software. In CP/M, there is a built-in function called Dir that displays a disc directory, but you need to use a separate program called Stat to find the sizes of each file. Although Stat forms part of CP/M in the sense that it is included in the purchase price, to the operating system it is just another application program.

So which operating system should the prospective purchaser favour? The answer depends largely on who you are. For a programmer, the choice of OS will depend on the services that the system offers in terms of system calls and debugging aids. If you are a system builder, putting together systems for non-technical users, you will need to look at the ease of operation and the degree to which the mechanics of operating can be automated.

For the person who simply wants to use a computer in his or her busines or profession, the choice of OS is mainly academic. What you are really investing your money in is a tool for doing a job, and this invariably means the application software. So your best bet is to concentrate your energies on finding the accounting package, word processor or whatever that best meets your needs, then seeing what operating systems it runs on, and then choosing a hardware configuration for which the operating system is available.

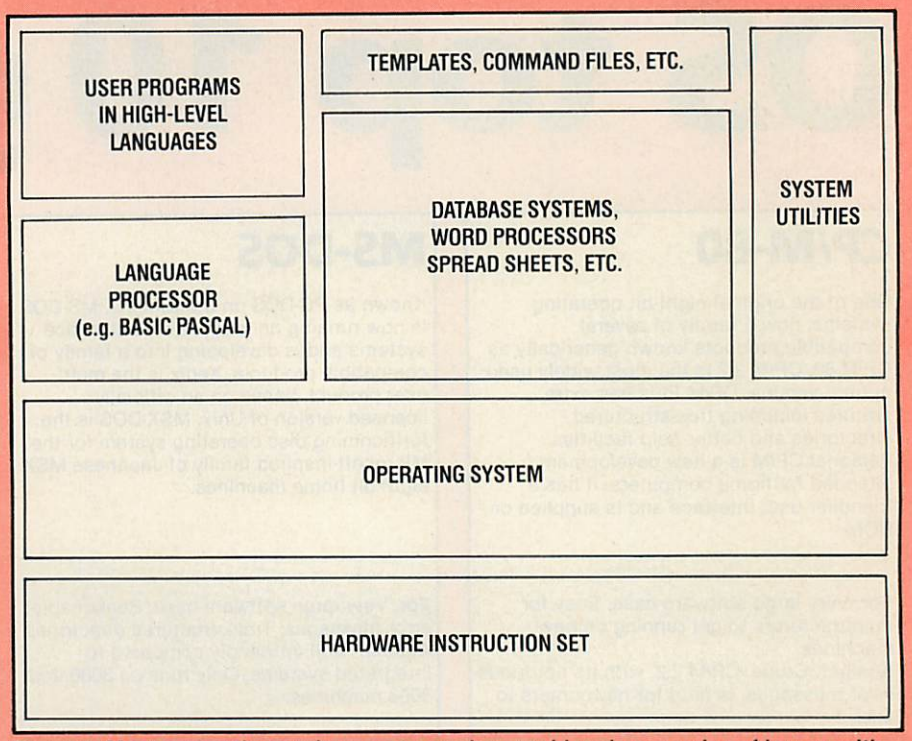
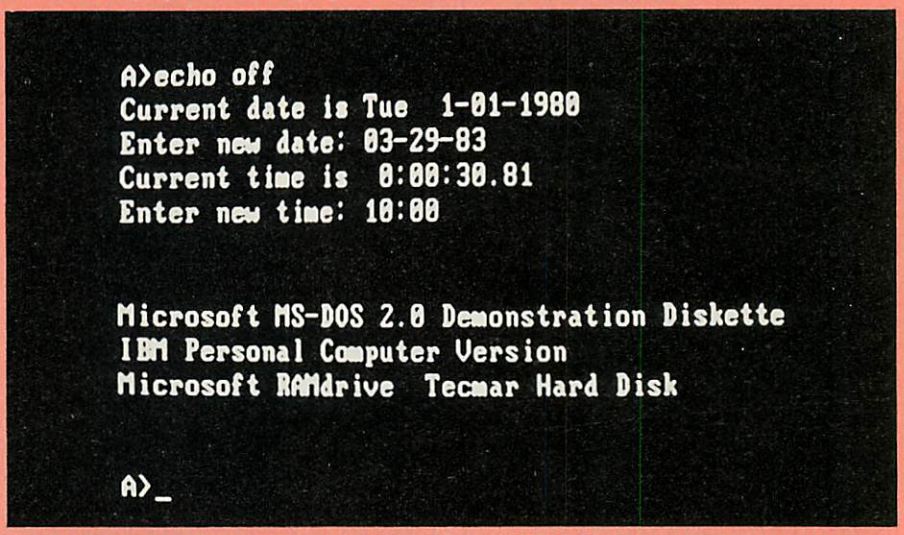
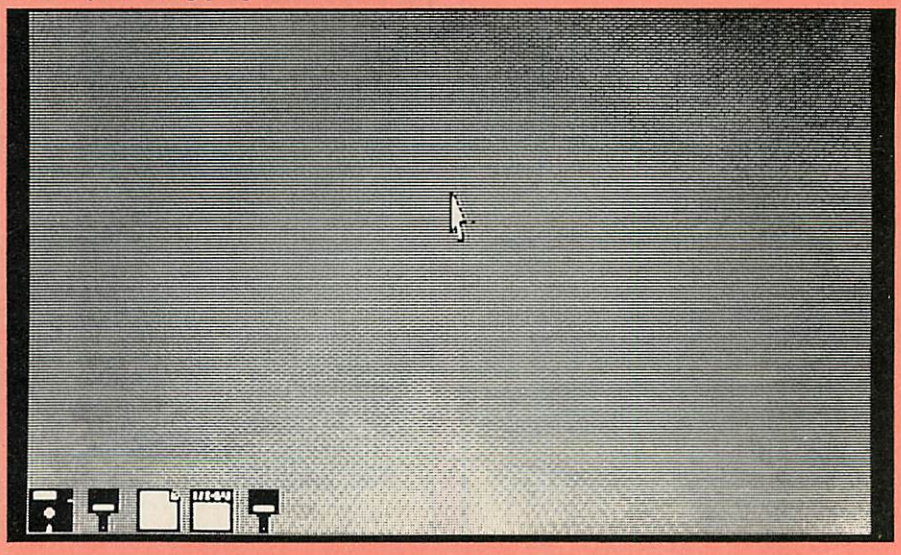

USER PROGRAMS IN HIGH-LEVEL LANGUAGES
TEMPLATES, COMMAND FILES, ETC.
SYSTEM UTILITIES
DATABASE SYSTEMS, WORD PROCESSORS SPREAD SHEETS, ETC.
LANGUAGE PROCESSOR (e.g. BASIC PASCAL)
OPERATING SYSTEM
HARDWARE INSTRUCTION SET

Figure 1. Most computing environments can be considered as a series of layers, with the operating system occupying a position close to the hardware.



Operating systems are getting friendlier. Above: MS-DOS's old-style opening screen. Below: How the new MS-DOS with Windows greets the user; along the bottom are icons representing programs the user can run.



Bridging the gap

Mike Lewis introduces our special section on operating systems with a discussion on why we need them and how to choose one.

CHOOSING A COMPUTER system has never been easy. First you are faced with a long and detailed search for the best software for your application. Then you have the equally difficult task of selecting the most suitable hardware to run it on. Recently, a third factor has emerged which is often as intractable as the other two: which operating system do you go for?

In the early days of microcomputing the question of which operating system to choose was extremely simple. There weren't any. On Commodore Pets and the earliest Apples, the only way of talking to the hardware was through a Basic interpreter, which usually carried out the minimum functions expected of an OS. Many smaller machines continue to use this approach and are none the worse for it.

As more sophisticated hardware came along, the problem changed. For several years the question was simply whether to use CP/M or the manufacturer's own machine-dependent operating system. I doubt if even Gary Kildall would claim that CP/M was the best OS around, but it did offer the one thing that the market was desperate for: the ability to run the same program on many different computers. For this reason CP/M became the dominating OS, a position which it still holds in the eight-bit world.

Fierce battle

With the arrival of the 16-bit processor, the situation became far more complicated. Today a fierce battle is in progress between CP/M, a clutch of new systems of which the market leader is undoubtedly Microsoft's MS-DOS, and various products like Unix and Pick, which have migrated from minis and mainframes.

If it all seems a bit bewildering, take heart. The articles on the next few pages will help you find your way round the operating-system jungle. Keep firmly in mind that the most suitable OS for you is not necessarily the one that is technically the best. Indeed, most users do not know or care what is going on within the OS, and many live happy and useful lives without ever being aware that it exists.

So what exactly are operating systems, and why do we need them? One function of the OS is to act as a bridge between the application software and the physical computer. If you are writing an accounting system or a database package, you do not want to have to worry about the way the disc directories are organised or which peripherals are attached to which ports. A good operating system will take care of all these details and a hundred others.

Say your accounts program wants to send a message to the printer. The program issues a Print command, or its equivalent in the appropriate language. The language processor, which might be a Basic interpreter or a compiler, converts this command to a set of machine-level instructions, one of which is a call to the operating system. The OS decides which port is assigned to the printer, checks its status, and prepares the message. Finally, the hardware outputs the required bytes to the relevant port.

The operating system is one of several layers of software that make up the total system, as shown in figure 1. Its exact functions vary from one environment to another, but it always forms the lowest layer, just above the hardware.

One of the most important tasks that a good OS performs is the management of discs. The hardware, in this case the disc controller, can do little more than read or write a specified track and sector. But application programmers must concern themselves with logical files, such as a name and address file or a word-processed text file. It is the operating system that forms the link between the user's files and the physical storage of data on the disc.

To do this, the OS maintains a directory of each disc in the system. At its minimum, this is a list of files containing the file name in a recognisable form and some sort of map of the tracks and sectors that the file occupies. So when the accounts program asks for the fifth record of the ledger file, the OS can tell the hardware exactly where to look for it.

Most operating systems go much further than this with their directory maintenance. Partitioning directories into separate units is a common feature, allowing different users to concentrate on their own little corners of the disc. Another often-seen device is automatic date and time stamping, so that you can always know when your file was last updated.

But perhaps the most obvious function

How to write an operating system

If you are thinking of writing your own operating system, pause before you start. The design work will be difficult, the coding tricky, and the level of detail highly precise. You will need an intimate knowledge of your hardware, and you will be faced with a new set of problems every time you want to move the system to another machine.

If you still want to go ahead, here is a check-list of the jobs that your operating system will need to perform. It is far from complete.

- Provide the means for assigning and reassigning logical I/O devices to physical ports.
- Carry out and monitor I/O.
- Organise the RAM; provide a work area for transient programs and mechanisms for loading programs, chaining between programs and passing parameters.
- Receive commands from the operator; interpret and act on these commands; provide the operator with typing and editing facilities for entering commands.
- Provide some form of batch processing of commands.
- Maintain disc directories; translate requests for logical files and records to physical disc addresses; perform physical reading and writing of the disc; monitor disc errors; format new floppy discs.
- Provide mechanisms for copying, deleting, renaming and dumping of files; report on disc usage and file sizes; handle read-only protection for files and discs, and date and time stamping of directory entries.
- Implement a password protection scheme.
- Provide programming tools and debugging aids, such as program traces and monitors.
- Monitor and process hardware interrupts.

cros should you buy one? them.

n floppy disks. The normal 5¾" size an store more than 100K.

If that information was news to ou, you'd probably be interested in ying the Sinclair Spectrum, or the tari 600XL.

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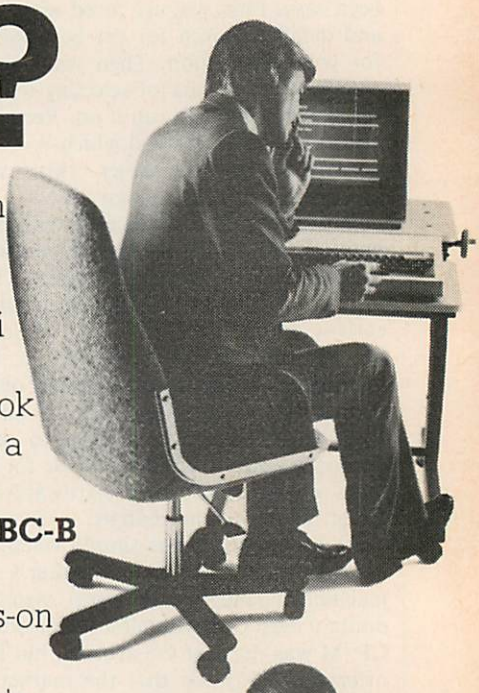

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A word of advice about micros:

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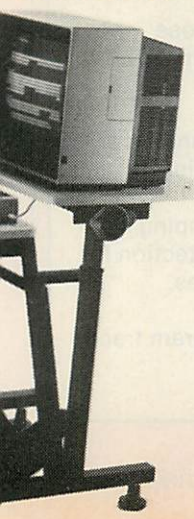

Atari 800 XL

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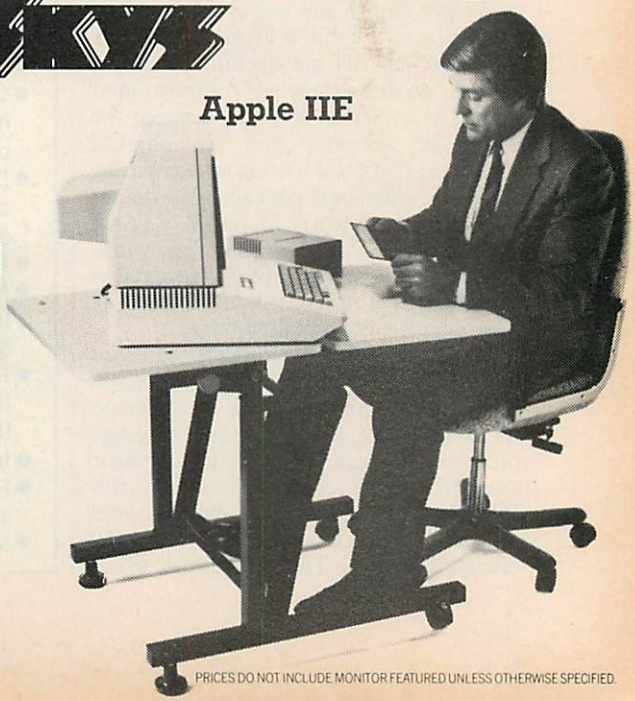

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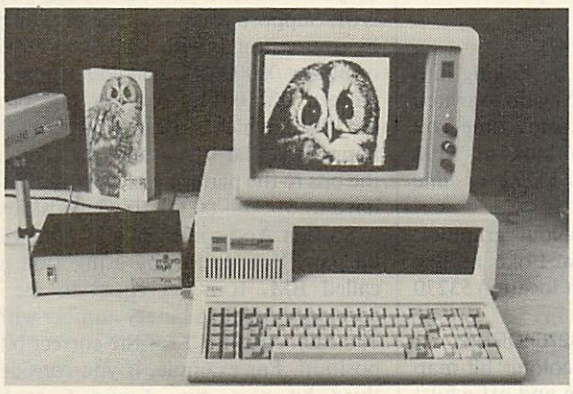

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```
SGN(NX-LX) : REM X FIXED
14020 Y = INT((X-LX)*S+LY+.5) : REM Y DERI
VED
14030 BI = CR*(4^FNBI(X)) : REM BITS TO MO
DIFY
14040 BM = 3*(4^FNBI(X)) : REM BITS TO MAS
K
14050 P = FNCO(0) : REM THIS LOCATION
14060 IF P > 8191 AND P < 16192 THEN POKE
P, (PEEK(P) AND (255-BM)) OR BI
14070 REM WITH THE ABOVE VALUE
14080 NEXT X
14090 RETURN
```

Listing 5.

```
0 REM C64 MULTICOLOUR HIRES, BORIS ALLAN
1 REM Y FIXED
2 REM
15000 S = 0 : IF LY-NY <> 0 THEN S=(LX-NX)
/(LY-NY)
15010 FOR Y=INT(LY+.5) TO INT(NY+.5) STEP
SGN(NY-LY)
15020 X = INT((Y-LY)*S+LX+.5)
15030 BI = CR*(4^FNBI(X))
15040 BM = 3*(4^FNBI(X))
15050 P = FNCO(0)
15060 IF P > 8191 AND P < 16192 THEN POKE
P,(PEEK(P) AND (255-BM)) OR BI
15080 NEXT Y
15090 RETURN
```

normally used to store the video number of a character at that corresponding location on the screen. The eight bits at each location in screen memory can store 256 different values, and because there are only 16 different colour values you can store two different sets of colours. Each set takes up four bits.

The fourth colour is stored at the location in colour memory which corresponds to the character block in which the pixel bits are set. Only the lower four bits of colour memory are used. The background colour used is the same throughout the screen, but the foreground colours can vary inexplicably from one character block to another.

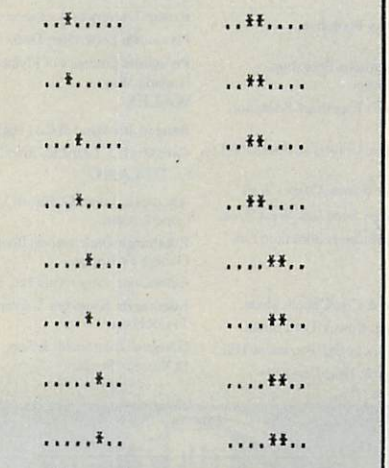

Figure 1. **Figure 2.**

A dot signifies 0, and an asterisk signifies 1.

The multi-colour high-resolution system is initialised by use of the subroutine at line 10000. It is worth comparing this to the earlier subroutine 10000 for two-colour high-resolution graphics which appeared in last month's article.

To start subroutine 10000 you clear the screen by typing

PRINT CHR$(147)

You then blank the screen by Poking into location 53265 which is used again to switch to bit-map mode. At the same time you direct the Vic-II chip to look at 8192 onwards by Poking into 53272 or line 10040.

Compared to the two-colour graphics, there is an important new Poke at line 10050, where you set bit 4 of location 53270 to be on by

POKE 53270, PEEK(53270) OR 16

This switches into multi-colour bit-map mode. Switching that bit on and off whilst set up for multi-colour can give some amusing effects. You clear the same patch of memory by Poking 0 into every location, which will set all bits to zero and all pixels to the background colour.

When the bit-map memory has been cleared, you initialise colours 01, 10, and 11. The colour corresponding to the bit pattern 01 is given by the upper four bits of the corresponding location in screen memory and the colour corresponding to the bit pattern 10 is given by the lower four bits of the same location in screen memory. You Poke the value 65 at line 10100 into the screen memory locations. In binary form the value 65 is 00100001, and when divided into two nybbles of four bits each this gives 0010 0001. These are the numbers 2 and 1.

Colour 1 is Red and has a colour code of 2 or 0010. Colour 2 is white and has a colour code of 1 or 0001. Thus pixels can be red or white when active, plus one other colour. The other colour is that given by colour memory. The colour set by colour memory — line 10110 — is 6, which corresponds to the colour code for blue. So the foreground pixels can be red, white or blue. The background on which the colours are drawn is that given by the Poke to location 53281 in line 10130. This Poke sets the background colour to yellow, which corresponds to a colour code of 7.

Finally, you switch on the screen to start work on the drawing of lines. To draw a line you make the call Gosub 12000, as with the two-colour system.

The functions are collected in subroutine 11000, and the only one to differ is FNBI(Z). As you are dealing with pairs of bits at a time such as 0,1; 2,3; 4,5; and 6,7 you do not want to change an individual bit. You do not alter the scaling of the X and Y axes and so all other functions are still operative. FNBI(Z) takes the bit position, divides it by 2 and strips off the fraction. FNBI now locates a bit pair from 0 to 3 rather an individual bit.

The routine at 14000 draws a straight line. You take the X axis as fixed and derive Y values from there. This is the same as the equivalent two-colour high-resolution routine, until line 14030 is reached, where it becomes apparent that you are not merely switching individual bytes.

For example, the bit pattern 00110001 is made up of four bit pairs. Bit pair 3 is 00, bit pair 2 is 11, bit pair 1 is 00, and bit pair 0 is 01. Suppose you want to change bit pair 0 by overwriting it with 10. If you Or with 2 or binary 00000010, then you produce a bit pattern 00110011. You do not produce 00110010, which is the desired effect. What happens is that 01 Or 10 is 11. To change the bits to the pattern you wish — 10 — you have to 01 And 00 Or 10 which is then 10.

So first And some zeros into the correct bit pair. You do this by using a bit mask, called BM. It is set equal to the value corresponding to a binary number with two bits each equal to 1, at the correct bit-pair position. For example, if you consider the third bit pair, bits 4 and 5 or binary 00110000, this is equal to 48 or 3*4^2.

The binary number you want to use to And is 11001111 or 207. This you find by subtracting 48 from 255. You set the binary number within the pair by

CR*2^FNBI(X)

where CR is the colour code to be used — the binary number is called BI.

The next major difference from the two-colour version occurs at line 14060. The value Poked is more complex in appearance because the value has to be first masked to zero. Apart from that there is little difference.

The multi-colour system is easy to use, as long as values are supplied for LX,LY and NX,NY, and a current value for CR from 1 to 3. There is no reason why, given patience as it is so slow, complex effects cannot be produced.

More colours on the 64

In the second part of his series on the Commodore 64, Boris Allan explains how to draw multi-colour graphics.

LAST MONTH'S article explained how to produce two-colour high-resolution graphics on the Commodore 64. The next step is to extend the coverage to more than two colours. The Commodore 64 makes provision for three colours per character block, plus the background colour.

Before you can start to use any form of high-resolution graphics, you have to move the base of Basic above the portion of memory used for the bit map. You move the base by

POKE 44,46 : POKE 16384,0 : NEW

In high-resolution graphics you are concerned with bits in an eight-by-eight block where there are 1,000 such blocks When you use high-resolution graphics, you are working towards the type of situation as shown in figure 1, which is what a straight line under magnification might look like drawn on the screen. Each bit or pixel within the character block can either be equal to 0 or 1. Two colours may be used, depending upon the value of the bit. The two colours for the block are set by screen memory for the corresponding character in low-resolution graphics.

Multi-colour mode is set by forcing bit 4 at location 53270 to a 1, which is Or 16. In this mode a straight line through the eight-by-eight block would look like figure 2. Now the resolution is halved and the line is two pixels or two bits wide. Since the resolution is less, the lines drawn are cruder approximations to straight lines.

As the number of bits per pixel has doubled, the number of colours the system can cope with is now four. Whereas previously you had two possible values, 0 and 1, you now have four possible values, and each value takes its colour cue from a different place. Table 1 gives the possible bit patterns and their corresponding colour cues. The background colour #0 is set by using location 53281. Location 53281 is normally used to set the colour of the background.

Screen memory is that portion of memory from 1024 to 1023 which is

00 — background colour #0
01 — upper four bits of screen memory
10 — lower four bits of screen memory
11 — lower four bits of colour memory

Table 1. Bit patterns and colour cues.

Listing 1.

```
0 REM C64 MULTICOLOUR HIRES, BORIS ALLAN
1 REM INITIALIZE
2 REM
10000 PRINT CHR$(147) : REM CLEAR SCREEN
10010 GOSUB 11000 : REM ACTIVATE FUNCTION
S
10020 POKE 53265, PEEK(53265) AND 239 : R
EM BLANK SCREEN
10030 POKE 53265, PEEK(53265) OR 32 : REM
BIT MAP MODE
10040 POKE 53272, (PEEK(53272) AND 240) O
R 8 : REM LOCATE CHARACTER MEMORY
10050 POKE 53270, PEEK(53270) OR 16 : REM
TURN ON MULTICOLOUR MODE
10060 FOR I=8192 TO 16192
10070 POKE I,0 : REM CLEAR THIS PATCH OF
MEMORY
10080 NEXT I
10090 FOR I=1024 TO 2023
10100 POKE I,65 : REM COLOUR 1 IS RED, CO
LOUR 2 IS WHITE
10110 POKE 54272+I, 6 : REM COLOUR 3 IS B
LUE
10120 NEXT I
10130 POKE 53281, 7 : REM BACKGROUND IS Y
ELLOW
10140 POKE 53265, PEEK(53265) OR 16 : REM
 SCREEN BACK ON
10150 RETURN
```

Listing 2.

```
0 REM C64 MULTICOLOUR HIRES, BORIS ALLAN
1 REM FUNCTIONS
2 REM
11000 DEF FNCO(Z) = 8192 + 320*FNCH(Y) + 8
*FNCH(X) + Y - 8*FNCH(Y) : REM LOCATION
11010 DEF FNCH(Z) = INT(Z/8)
11020 DEF FNBI(Z) = INT((7 + FNCH(Z)*8 - Z
)/2) : REM BIT PAIR
12030 RETURN
```

Listing 3.

```
0 REM C64 MULTICOLOUR HIRES, BORIS ALLAN
1 REM LINE CHOICE
2 REM
12000 IF ABS(LX-NX) >= ABS(LY-NY) THEN GOS
UB 14000 : REM X FIXED
12010 IF ABS(LX-NX) < ABS(LY-NY) THEN GOSU
B 15000 : REM Y FIXED
12020 RETURN
```

Listing 4.

```
0 REM C64 MULTICOLOUR HIRES, BORIS ALLAN
1 REM X FIXED
2 REM
14000 S = 0 : IF LX-NX <> 0 THEN S=(LY-NY)
/(LX-NX) : REM GRADIENT
14010 FOR X=INT(LX+.5) TO INT(NX+.5) STEP
```

(continued opposite)

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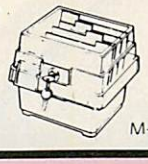
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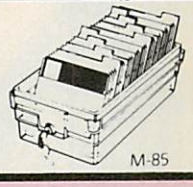
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Native wit

John Cookson looks at three books on advanced programming.

A COMMON complain against computer science graduates is that they enter the computer industry like missionaries going into a land of primitive tribesmen. They often find practices current which are at variance with their training and frequently make this clear to the natives. Not suprisingly the natives resent it.

Gary D Brown's book *Beyond Cobol* aims to provide a bridge between what the student has learned at college or university and what happens in commercial data processing. It gives novice business programmers in Cobol an introduction to techniques they will probably be using in the early stages of their career. A particular merit of the book is that it makes clear that business applications can be challenging and difficult.

You are taken through the basics of collecting data, validation, updating, handling files, tables, sorting and merging, databases, producing reports, documentation and maintenance programming. But in a short book like this there are obviously going to be weak areas, notably the discussions of on-line systems and databases which are too shallow to be really useful.

There are few texts on programming languages as useful, well written and clear as Martin Richards and Colin Whitby Stevens' *BCPL — The Language and its Compiler*. BCPL is a simple but effective systems programming language which is now enjoying an increased popularity as microcomputer implementations are appearing.

The basic features of the language are covered quickly and concisely. Throughout the book the authors present sensible approaches to developing good programming style in BCPL. The library, language extensions and considerations of machine independence are dealt with in sufficient depth with some useful guidelines to BCPL style for portability. Especially welcome are the explanations of programming holes into which programmers experienced in other languages might fall.

While small examples may be appropriate to novices interested in learning the syntax of a language, for systems programmers a more substantial example is more useful. In this case the authors have included a complete listing of the lexical and syntax analysis phases of the BCPL compiler. This is given with a helpful — and essential — commentary on the code.

Although the code is clear with the aid of the commentary the standard of internal documentation is lamentable. Again this is unlikely to worry systems programmers.

The book is an excellent text for experienced programmers. The section on the BCPL compiler is of interest to anyone involved with compiler construction, particularly as supporting material for a course on compiler writing.

Of the new generation of 16-bit micros, the Motorola 68000 is perhaps the most interesting and it is covered in Leo J Scanlon's *The 68000: Principles and Programming*. Several aspects are particularly significant, notably its 32-bit internal architecture, enormous address range, many addressing modes and number-crunching potential. Unlike earlier 16-bit machines a strong aspect of the Motorola is a collection of features to provide support for high-level languages and multi-tasking and multi-programming.

Unfortunately, Scanlon's book does not deal with this last aspect in the same depth as the others. It is aimed more at the practical engineer who may have used eight-bit or four-bit microprocessors rather than the software enthusiast who may be interested in developing products at a higher level.

Scanlon discusses the architecture, instruction set, cross-macro assembler, processing states, interfacing and system-development support. In addition a number of programming examples are given of mathematical routines and the use of lists and look-up tables. But the latter does not integrate well with the rest of the book and the author seems more at home with the hardware than the software.

The quality of the discussion is generally very good. Comprehensive references are given at the end of each chapter, and give you a good introduction to the literature. Overall, the book is well worth buying for anyone seriously interested in 16-bit microprocessors.

Beyond Cobol by Gary D Brown. Published by Wiley Interscience, 200 pages, £12.25 hardback, £8.25 paperback

BCPL — The Language and its Compiler by Martin Richards and Colin Whitby Stevens. Published by Cambridge University Press, 173 pages, £4.95

The 68000: Principles and Programming by Leo J Scanlon. Published by Blacksburg Continuing Education Series, Howard W Sams Inc.

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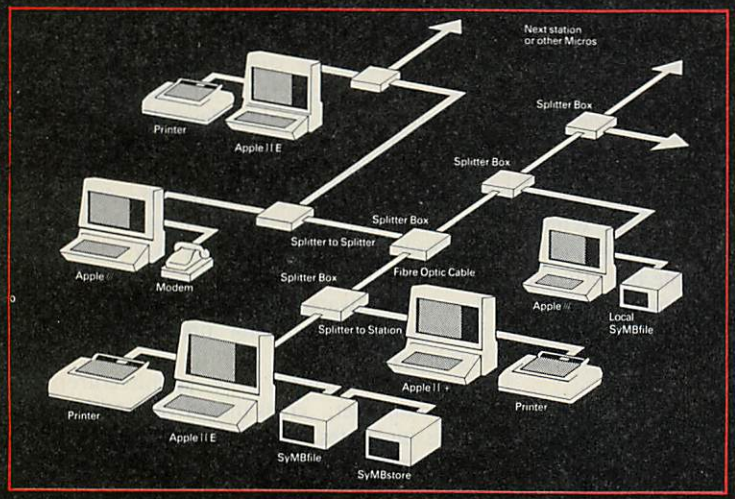

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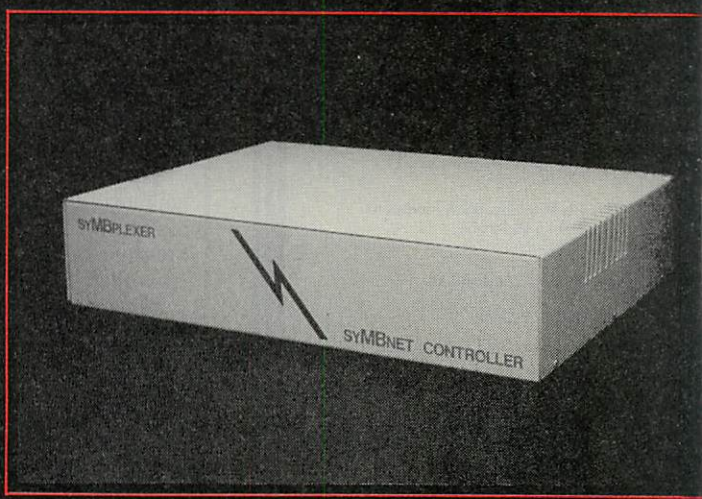
SYMBNET is a "tree and branch" network system using fibre optic cable to allow several microcomputers to share a common SYMBFILE. SYMBNET is the fastest long range local area network for microcomputers, and can cover a range of 7-9 Kilometres, fibre optics means that SYMBNET is more cost effective; it uses a high intensity semi-conductor laser to transmit data and cables can be laid at the shortest route, whereas other networking systems use flat ribbon or coaxial cable which is sensitive to electrical noise from fluorescent lights, photocopiers, etc. SYMBNET is compatible with DOS, Pascal, SOS, and CP/M running on any microcomputer supported by the SYMBFILE in concurrent operation.



SYMBPLEXER
NETWORK CONTROLLER

The SYMBPLEXER is a network controller which complements SYMBNET SYMBPLEXER is connected directly to the SYMBFILE and performs all read-w operations to and from the hard disk. SYMBPLEXER does away with the need fo central machine thus releasing another terminal to run any application you wi being a dedicated device the read-write operations are performed very efficient the support software allows SYMBPLEXER to designate pass codes for each user a to decide which user may access which applications. If you are currently us SYMBNET , accessing your SYMBFILE via a central machine, the addition o SYMBPLEXER will in no way change the operational capabilities of the network

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PRACTICAL COMPUTING APRIL 1984

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Commodore ..... Mike Todd
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Open File is the part of the magazine written by the readers of *Practical Computing*. All aspects of microcomputing are covered, from games to serious business software and utilities. Fully-debugged programs can be submitted for any micro, and for standard CP/M machines such as the Osborne and Superbrain. Programs can be in machine code or any language, including Forth and Pascal.

Submissions should include a brief description which explains what your program does, and how it does it. If possible it should be typed, with lines double-spaced. We need a printed program listing. Hand-written listings cannot be accepted. A tape or disc of the program helps if it is in a standard format.

When printing listings, please remember to use a new ribbon or double-intensity printing — faint listings reproduce badly. Use plain paper only, and try to list the program across either a 35-character or a 70-character width. Also, make sure all special graphics or inverse-video characters are either listed correctly or else include Rem statements to explain them fully.

Each program listing, tape or disc must have your name and address on it, or we cannot promise its safe return. A stamped addressed envelope is appreciated.

If you write in with a comment, correction or enquiry please remember to state the machine and the program title.

We pay at least £10 for any programs used, or £35 per page and pro rata for part pages.

>COMMODORE

148 DIRECTORY SORTER Finding programs on discs containing large numbers of files can often be difficult, but Laurie Faulkener's program helps by sorting the directory into alphabetical order.

148 VIC PATTERN MAKER An unusual drawing program for the unexpanded Vic-20, written by B M Phillips.

>SHARP

152 FOOD VALUES Weight watchers and dieticians will be interested in Dr Frank Rooney's Basic program, which gives you the energy values — in calories or kilojoules — for any quantity of up to 255 different foodstuffs.

152 PRINT/P Printing draft-format programs can waste a great deal of paper, so J S Levett has devised this routine for the MZ-80K which lets you direct material to the screen first, so that revisions can be made before printing.

153 SCREEN DUMP Not entirely unrelated is M D deBokx's program, also for the MZ-80K, with which you can dump any screen display straight to the printer.

153 HIDDEN LINES A correction to the routine to reveal hidden program lines, which appeared in the February Sharp Open File.

153 SUBROUTINE CALLS Sharp Basic does not normally permit subroutine calls to be made to a calculated variable, but with the help of this short routine it will.

>SINCLAIR

155 WHITE NOISE You can enhance the Spectrum's meagre sound-producing capabilities with this routine by Duncan Stokes.

155 MAZOR A bright version of the popular maze game written in Basic by R D Lancaster.

>BBC

160 DISASSEMBLER Make sense of your machine-code programs with this full-scale disassembler, which has itself been written in machine code by C Dunne.

161 CASSETE BOX INSERTS With this program from Ian Masters you can print labels for audio cassettes and computer tapes.

>TANDY

163 GRAPHING Any mathematical function will be represented on the screen in graphical form by this Basic program from Jason Smith.

164 REINFORCE A neatly programmed Basic game is provided by Stephen Daniels.

>ATARI

167 KEYBOARD SUPPRESS How to stop people tinkering with your keyboard and playing havoc with your programs.

167 BLINKING ATARI Blinking characters are not provided as standard on Atari micros, but if you need them Nick Pearce has the program which provides them.

Send your contribution to:

Open File, Practical Computing, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS

Directory sorter

FINDING PROGRAMS on discs containing large numbers of files can often be difficult, even with a hard copy of the directory. An alphabetically ordered directory would make life so much easier.

You could generate one by copying the files from one disc to another, sorting the program titles in the process. But it is possible to sort the directory on the disc itself, and Laurie Faulkener of Leicester has provided a program which does just this.

The program is written for the 3040 disc drive using DOS 2 with Basic 4, and it also works with a 1541 running with a Vic-20 or Commodore 64 since the only Basic 4 command is the Directory in line 490, which can be left out.

The program fetches all the details of each file into a string in lines 250 to 300. If the details are of a deleted file, the file name is replaced with ZZZZZZ so that it appears at the end of the directory. Once the complete directory has been read, the file names are sorted using a simple Shell-Metzner sort in lines 320 to 360, and then rewritten to the disc in lines 360 to 440.

The program can be amended to work with the 8050 disc drive, noting that the directory track is 39 and not 18 — see lines 170 and 360.

```
100 PRINT"[CLEAR,DOWN6]~~~~~[RVS]
    ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~"
110 PRINT"~~~~~[RVS]~DISK~DIRECTORY~S
    ORT~PROGRAM~"
120 PRINT"~~~~~[RVS]~~~~~~~~~~~~~~~~
    ~~~~~~~~~~~~~"
130 PRINT"~~~~~[RVS]~BY~LAURIE~FAULKN
    ER~NOV~1983~"
140 PRINT"~~~~~[RVS]~~~~~~~~~~~~~~~~
    ~~~~~~~~~~~~~"

150 GOSUB 450:F$="UNSORTED":GOSUB 480
    :GOSUB 450

160 PRINT"[CLEAR]":T$="READING~FILENA
    MES":GOSUB 500
170 DIM A$(150),S(20):S(0)=1:T=18
    :C$=CHR$(0)+CHR$(0)
180 N$=C$+C$+C$+C$+C$+C$+C$:N$=N$+N$

190 OPEN 15,8,15,"I0":GOSUB 510

200 OPEN 2,8,2,"#":GOSUB 510
210 PRINT#15,"U1";2;0;T;S(V):GOSUB 510
220 GET#2,T$:IF T$=""THEN T$=CHR$(0)
230 GET#2,S$:IF S$=""THEN S$=CHR$(0)
240 V=V+1:T=ASC(T$):S(V)=ASC(S$)
250 FOR J=1 TO 8:K=K+1:A$(K)=""
    :FOR I=1 TO 30
260 GET#2,B$:IF B$=""THEN B$=CHR$(0)
270 A$(K)=A$(K)+B$:NEXT
280 IF J<>8 THEN GET#2,X$:GET#2,X$
290 IF LEFT$(A$(K),1)=CHR$(0)THEN A$(
    K)="ZZZZZZ"+RIGHT$(A$(K),24)
300 NEXT:IF T>0 GOTO 210

310 T$="SORTING~FILENAMES":GOSUB 500
320 M=INT(K/2):FOR A=-1 TO 0 STEP 0
    :FOR J=1 TO K-M:FOR H=J TO 0 STEP
    -M:L=H+M:P=0
330 IF RIGHT$(A$(H),27)>RIGHT$(A$(L),
    27)THEN Z$=A$(H):A$(H)=A$(L)
    :A$(L)=Z$:P=H
340 H=P:NEXT:NEXT:M=INT(M/2):A=(M>0)
    :NEXT:FOR R=1 TO K
350 IF LEFT$(A$(R),6)="ZZZZZZ"THEN A$
    (R)=N$:GOTO 360
360 NEXT:T$="WRITING~FILENAMES"
    :GOSUB 500:K=1:V=1:T=18
370 PRINT#15,"B-P";2,0:GOSUB 510
380 IF S(V)=0 OR S(V)=255 THEN T=0
390 PRINT#2,CHR$(T);CHR$(S(V));
400 FOR J=1 TO 8:PRINT#2,A$(K);:K=K+1
410 IF J<>8 THEN PRINT#2,C$;
420 NEXT:PRINT#15,"U2";2;0;18;S(V-1)
    :GOSUB 510
430 IF T=18 THEN V=V+1:GOTO 380
440 CLOSE 2:F$="SORTED":GOSUB 480:END
450 PRINT"[DOWN2]~~~~~**~PRESS~[RVS]
    RETURN[RVOFF]~WHEN~READY~**"
460 GET A$:IF A$<>CHR$(13)GOTO 460
470 RETURN

480 PRINT"[CLEAR]~~~~~~~~"F$"~DISK~
    :[DOWN]"
490 DIRECTORY  D0:RETURN
500 PRINT"[DOWN3]~~~~~~~~[RVS]"T$
    :RETURN

510 INPUT#15,EN,EM$,ET$,ES$
520 IF EN=0 THEN RETURN
530 PRINT"[RVS]"EN,EM$,ET$,ES$:STOP
```

Vic pattern maker

B M Phillips has submitted a drawing program for the unexpanded Vic-20.

Once the border and screen colours have been selected — by pressing the space bar during the changing colour sequence — the main drawing area is set up with a flashing cursor. This cursor can be moved using the joystick or the keyboard and its shape is deposited in the drawing area by pressing the fire button or space bar.

To change its shape or colour you place it over the required shape or colour in the border and press the fire button or the space bar.

Pattern maker.

```
10 POKE 36869,242
20 PRINT"[CLEAR,DOWN,RIGHT4,RED]
   PATTERN~MAKER"
30 PRINT"[DOWN2,RIGHT,BLUE]
   THIS~PROGRAM~ALLOWS~~~YOU~TO~CREAT
   E~YOUR~~~~OWN~PICTURES~OR~"
40 PRINT"[RIGHT]PATTERNS~USING~THE~~~
   ~SHAPES~PROVIDED."
50 PRINT"[DOWN,RIGHT]USE~KEYS~I~J~L~&
   ~M~OR~THE~JOYSTICK~TO~MOVE~~THE~CU
   RSOR~AND~THE~"
60 PRINT"[RIGHT]SPACE~BAR~OR~FIRE~~~~
```

```
   ~BUTTON~TO~PICK~UP~~~~~SHAPES~OR~C
   HANGE
70 PRINT"[RIGHT]THE~COLOUR.[DOWN,
   LEFT11,DOWN]O~IS~A~BLANK."
80 PRINT"[DOWN,RIGHT,BLACK]
   PRESS~C~TO~CONTINUE"
90 GET A$:IF A$<>"C"THEN 90
100 PRINT"[CLEAR]":POKE 36869,240
110 P1=8164:P2=38884
120 PRINT"[CLEAR,DOWN6,RIGHT,BLACK]
    CHOOSE~BORDER~COLOUR"
130 PRINT"[DOWN3,RIGHT]
    PRESS~SPACE~TO~STOP"
140 FOR I=24 TO 31
150 BD=I-16
160 POKE 36879,I
170 FOR J=1 TO 250
180 GET A$:IF A$="~"THEN J=100:I=31
    :S1=1
190 NEXT J,I
200 IF S1=0 THEN 140
210 PRINT"[CLEAR,DOWN6,RIGHT]
    CHOOSE~SCREEN~COLOUR"
220 PRINT"[DOWN3,RIGHT]
    PRESS~SPACE~TO~STOP"
230 FOR I=BD+128 TO BD+240 STEP 16
240 POKE 36879,I
250 FOR J=1 TO 250
260 GET A$:IF A$="~"THEN J=500
    :I=BD+240:S1=0
270 NEXT J,I
280 IF S1=1 THEN 230
290 PRINT"[CLEAR,RIGHT5]S~H~A~P~E~S
    [LEFT12,DOWN21]C~O~L~O~U~R~S"
300 FOR X=2 TO 18 STEP 2
310 READ D:POKE P1+X-462,D
    :POKE P2+X-462,0
320 NEXT X
330 FOR X=3 TO 17 STEP 2
340 READ D:POKE P1+X-22,204
    :POKE P2+X-22,D
350 NEXT X
360 FOR X=2 TO 19
370 POKE P1+X-44,99:POKE P2+X-44,0
    :POKE P1+X-440,100:POKE P2+X-440,0
380 NEXT X
390 FOR Y=3 TO 19
400 POKE P1+1-22*Y,103
    :POKE P2+1-22*Y,0:POKE P1+20-22*Y,
    101:POKE P2+20-22*Y,0
410 NEXT Y
420 DIM JS(2,2):POKE 37139,0:DD=37154
    :PA=37137:PB=37152
430 FOR I=0 TO 2:FOR J=0 TO 2
    :READ JS(J,I):NEXT J,I
440 X=2:Y=19:SH=160:CL=0:NT=234
450 PRINT"[HOME,BLACK,DOWN4]F[LEFT,
    DOWN]2[LEFT,DOWN2]T[LEFT,DOWN]O
    [LEFT,DOWN2]S[LEFT,DOWN]T[LEFT,
    DOWN]O[LEFT,DOWN]P"
460 PRINT"[HOME,BLACK,DOWN4,RIGHT21]F
    [LEFT,DOWN]8[LEFT,DOWN2]T[LEFT,
    DOWN]O[LEFT,DOWN2]E[LEFT,DOWN]R
    [LEFT,DOWN]A[LEFT,DOWN]S[LEFT,
    DOWN]E"
470 GET A$:GOSUB 810
480 IF A$="J"THEN X=X-1
    :IF X<2 THEN X=2
490 IF A$="L"THEN X=X+1
    :IF X>19 THEN X=19
500 IF A$="I"THEN Y=Y+1
    :IF Y>21 THEN Y=21
510 IF A$="M"THEN Y=Y-1
    :IF Y<1 THEN Y=1
520 IF A$="[F2]"THEN PRINT"[CLEAR]"
    :POKE 36879,27:END
530 IF A$="[F8]"THEN GOSUB 740
540 K1=PEEK(P1+X-22*Y)
    :K2=PEEK(P2+X-22*Y)
550 IF A$="~"THEN GOSUB 600
560 POKE P1+X-22*Y,SH:POKE P2+X-22*Y,
    CL
570 FOR T=1 TO 25:NEXT T
580 POKE P1+X-22*Y,K1:POKE P2+X-22*Y,
    K2
590 GOTO 470

600 IF Y=1 THEN CL=PEEK(P2+X-22*Y)
    :NT=200+X*2:GOSUB 650:RETURN
610 IF Y=21 AND PEEK(P1+X-22*Y)<>32 T
    HEN SH=PEEK(P1+X-22*Y):NT=150+X*2
    :GOSUB 650:RETURN
620 IF Y=21 OR Y=20 OR Y=2 THEN RETURN
630 K1=SH:K2=CL:GOSUB 700
    :IF K1=87 THEN K1=32
640 RETURN

650 POKE 36876,NT
660 FOR I=15 TO 1 STEP-1
670 POKE 36878,I:NEXT I
680 POKE 36876,0
690 RETURN

700 POKE 36878,15:POKE 36875,NT
710 FOR I=1 TO 50:NEXT
720 POKE 36878,0:POKE 36875,0
730 RETURN

740 FOR I=2 TO 19
750 FOR J=3 TO 19
760 POKE P1+I-22*J,32
770 NEXT J,I
780 RETURN
790 DATA 87,81,160,233,223,105,95,93,
    67,0,1,2,3,4,5,6,7
800 DATA-23,-22,-21,-1,0,1,21,22,23
810 POKE DD,127:S3=-((PEEK(PB)AND 128
    )=0):POKE DD,255
820 P=PEEK(PA):S1=-((P AND 8)=0)
    :S2=((P AND 16)=0)
    :S0=((P AND 4)=0)
830 FR=-((P AND 32)=0)
840 IF S0<>0 THEN A$="I"
850 IF S1<>0 THEN A$="M"
860 IF S2<>0 THEN A$="J"
870 IF S3<>0 THEN A$="L"
880 IF FR<>0 THEN A$="~"
890 RETURN
```

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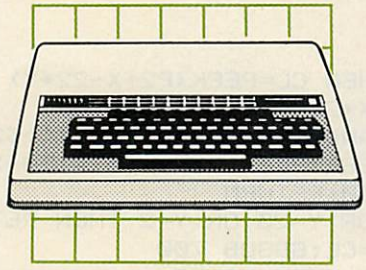

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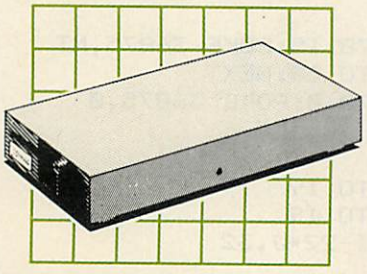

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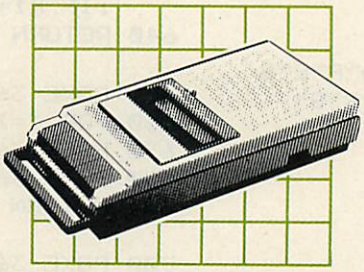

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BBC DATA RECORDERS – complete with lead for connection to BBC computer
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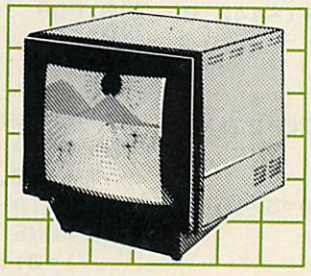

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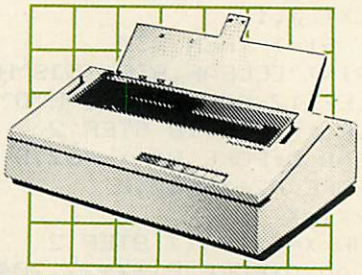

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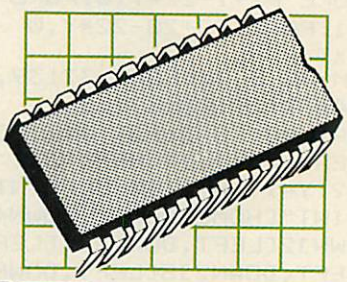

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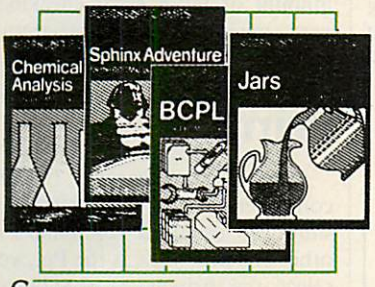

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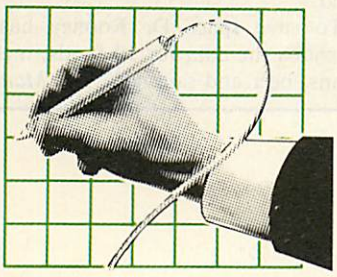

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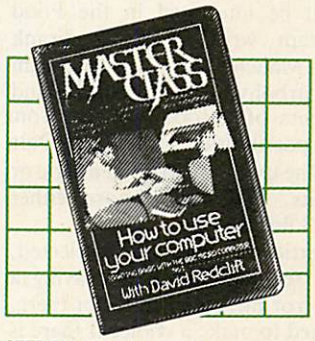

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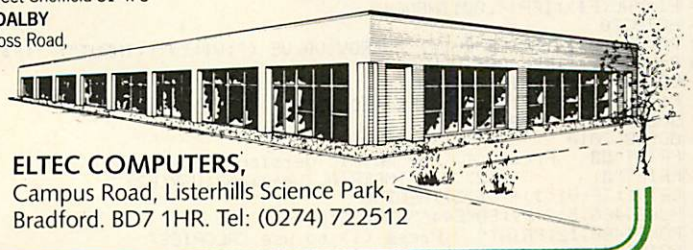

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Food values

FOOD SCIENTISTS, nutritionists and weight watchers will be interested in the Food Value program written by Dr Frank Rooney of Manchester. The program displays the carbohydrate, protein, fat and energy contents of a food selected from up to 255 possibilities stored in Data statements. The user may work in metric or imperial units, and can choose either kilojoules or kilocalories.

When a particular food item is selected, the program searches for it, displaying a Not Found error message if it is not there. You are invited to make a choice if there is more than one available, and the program then provides a table of the composition and energy value of a standard quantity. You may then select from a menu, either to see values for a chosen quantity, to see the amount having any particular energy content, to change units or to try a different food.

To save space Dr Rooney has only provided the data for 18 foods, including beans, beer and sausages. *The Manual of Nutrition*, published by HMSO, contains all the others you might want to see. Remember to alter the value of N in line 110 if you add to the list.

This version of the program runs under SP-5025. The Pokes to 4465 and 4466 move the cursor to the Xth column and Yth row and USR(62) goes beep. There is a limited amount of input error checking, but not very much, and the program needs a friendly user.

Food values.

```
10 REM FOOD VALUES - SHARP MZ-80K
20 REM FRANK ROONEY - OCT 83
30 GOSUB 2010
80 PRINT"■■■■  PLEASE WAIT WHILE THE DATA IS READ"
110 N=18:REM■■■■■■NO. OF ITEMS■■■■■■
120 DIMA$(N),B$(N),C$(N),E(N,5),X(N,5),F$(5),NI(10)
130 FORI=2TO5:READF$(I):NEXTI
140 DATACarbohydrate,Protein,Fat,Energy Value
150 FORI=1TON:READA$(I),B$(I),C$(I)
160 FORX=1TO5:READE(I,X):NEXTX:NEXTI
170 GOSUB730
190 GOSUB 2010:J=0:INPUT"■Enter food: ";X$:PRINT:I=0
200 OK=0:I=I+1:IFI>NTHEN260
210 IF(A$(I)=X$)+(LEFT$(A$(I),LEN(A$(I))-1)=X$)THENOK=1
220 IFA$(I)=LEFT$(X$,LEN(X$)-1)THENOK=1
230 IFOK=0THEN200
240 NI(J)=I:J=J+1:I1=I:PRINTI;TAB(5);A$(I);:IFB$(I)="-"THENPRINT:GOTO200
250 PRINT" - ";B$(I):GOTO200
260 IFJ=0THENPRINT"■Item not found":MUSIC"":C1C2":FORD=1TO1000:NEXTD:GOTO190
270 IFJ=1THENI=I1:GOTO290
280 POKE4466,11:PRINTSPC(39):POKE 4466,11:USR(62)
285 INPUT"Select No. required: ";I:IF(I<1)+(I>N)THEN280
287 OK=0:FORQ=0TOJ:OK=OK-(I=NI(Q)):NEXTQ:IFOK=0THEN280
290 P1=E(I,1):F1=1:F2=1
310 IF(C$(I)="S")*(V1=1)THENU$="g":V$=U$
320 IF(C$(I)="L")*(V1=1)THENU$="ml":V$="g"
330 IF(C$(I)="S")*(V1=2)THENU$="oz":V$=U$:F1=F1*.16:F2=35
340 IF(C$(I)="L")*(V1=2)THENU$="fl oz":V$="oz":F1=F1*.2:F2=35
350 W$="Cal":IFV2=2THENF2=F2*4.184:W$="kJ"
360 P1=P1*F1
370 PRINT"■";A$(I);:L=LEN(A$(I)):IFB$(I)="-"THENPRINT:GOTO390
380 PRINT" - ";B$(I):L=L+3+LEN(B$(I))
390 FORM=1TOL-1:PRINT"-";:NEXTM:PRINT"-"
400 P2=P1:IFP2>9THENP2=INT(P2+.5)
410 IF(E=1)*(P2<1)THENPRINT"per ";F$;" ";U$;" portion":GOTO440
420 P2=(INT(10*P2+.5))/10
430 PRINT"per";P2;" ";U$;" portion"
440 PRINT"■┌──────────┬──────────┐"
450 FORJ=1TO3
460 PRINT"├──────────┼──────────┤":NEXTJ
470 FORO=2TO5:POKE4466,1+O*2
480 V$=V$:X(I,O)=E(I,O)*P1/E(I,1)
490 IFO>4THENX(I,O)=X(I,O)*F2:V$=W$
500 X(I,O)=INT(X(I,O)*100)/100
510 PRINT"| ";F$(O);TAB(16);"(";V$;")";TAB(22);"|";
520 PRINTTAB(31-INT(LEN(STR$(INT(X(I,O))))));X(I,O);TAB(39);"|"
530 NEXTO
540 PRINT"■└──────────┴──────────┘"
550 POKE4466,17:PRINT"■■■Press <1> for DIFFERENT portion"
560 PRINT"■          <2> to CALCULATE PORTION with"
570 PRINTTAB(13);"specified ENERGY VALUE"
580 PRINT"■          <3> to CHANGE UNITS"
590 PRINT"■          <4> to move on to next food■":USR(62)
600 GETF$:E=VAL(F$):IF(E<1)+(E>4)THEN600
610 USR(62):POKE4466,16:PRINTSPC(40)
620 ONEGOTO640,680,720,190
640 POKE4466,14:PRINT"Enter PORTION (";U$;")";:INPUT": ";F$
650 POKE4466,14:PRINTSPC(40)
660 P1=VAL(F$):IFP1<.001THEN640
670 GOTO370
680 POKE4466,14:PRINT"Enter ENERGY VALUE (";W$;")";:INPUT": ";F$
690 F=VAL(F$):IFF<.001THEN680
700 POKE4466,14:PRINTSPC(40)
710 P1=F/(E(I,5)*F1/E(I,1)*F2):GOTO370
720 GOSUB730:GOTO290
730 GOSUB 2010
735 PRINT"■■   Press <1> for METRIC version"
740 PRINT"■          <2> for IMPERIAL version":USR(62)
750 GETV1:IF(V1<1)+(V1>2)THEN750
760 POKE4466,5+2*V1:POKE4465,35:PRINT"←"
770 POKE4466,12:PRINT"   Press <1> to use CALORIES"
780 PRINT"■          <2> to use KILOJOULES":USR(62)
```

(listing continued on opposite page)

Print/P

One of the features of Sharp MZ computers is that the printer is selected simply by using the command Print/P. In other systems, such as the Pet, you have to select the printer as the output device instead of the screen.

But if a program is still in the debugging stage, you can waste a lot of paper unless everything for the printer can first be sent to the screen. A deal of time is then spent converting back and forth between Print and Print/P. Again, if a program is to display information both on the screen and on the printer two memory-wasting sets of program lines are needed, one using Print and the other identical but for the use of Print/P. It might after all be advantageous if output could be directed at will either to screen or printer by a single command.

According to J S Levett of Chelmsford, Essex this is possible, or at least it is on the MZ-80K using Basic SP-5025. The secret lies in the SP-5025 Print command code. The command is dealt with at memory locations 1C2F to 1CCF inclusive. It starts with a routine to find whether it is merely a Print, directed to the screen, or is followed by the / token and then either T or P to indicate the tape deck or the printer.

Various tests are done in this routine, but if /P is established then at 1C43/4 the B register is loaded with 80. If there is no / then it is loaded with 00. Subsequently the I/O system is set to screen if B is 00, to tape if B is 01 or to printer if B is 80. If the call to the device-finding routine is replaced by a jump directly to the location where the B register contents are set to indicate that the output device is the printer then all subsequent Prints will be interpreted as though they are Print/Ps. If the B register is loaded at 1C43/4 with 00 then all printing will go to the screen even if the command is Print/P.

In the first case, locations 1C31/2/3 need to hold the numbers C3/43/1C. The Poke to code into is

```
POKE 7217,195
POKE 7218,67
POKE 7219,28
```

In the second case, the 80 in location 1C44 is replaced by 00, that is Poke 7236,0.

Print may not always Print/P in the same

way, especially when it comes to dealing with text with embedded cursor-control, or Home/Clear symbols. At some time it may be necessary to reverse the change, so to restore Print try

```
POKE 7217,205
POKE 7218,139
POKE 7219,22
```

and to restore Print/P try Poke 7236,128.

Put into practice while debugging a section of code, sending text to the printer is easy. Simply write the code as though to print to the printer, but Poke 7236,0 at its start and Poke 7236,128 at its end. Printing both to the screen and to the printer is more difficult, but can be accomplished by a two-pass For-Next loop round the section of code, with the import of Print or Print/P changed to one pass only. For example

```
10 FOR PQ = 0 TO 1
20 IF PQ THEN POKE 7217,195: POKE
   7218,67: POKE 7219,28: REM P TO P/P
30 PRINT "This is the Text."
40 PRINT "And here's some more!"
50 POKE 7217,205: POKE 7218,139: POKE
   7219,22: REM P/P TO P
60 NEXT PQ
```

will print to the screen the first time through, but will go to the printer on the second.

Screendump

From Holland, home of many Sharp users and lovers, comes M H de Bokx and his MZ-80K Screendump, a Basic program that copies the screen to your printer. Mr de Bokx takes an obvious — once you've thought of it — but effective course, albeit a rather slow one. He Peeks each screen memory location, covering the 1,000 bytes from 53248 to 54247 inclusive, then converts the display code to ASCII using a look-up table, and finally sends the result to the printer using Print/P CHR$().

The program he sent in contained a number of fairly trivial bugs, and while correcting them I took the opportunity to rewrite the code into a slightly neater form.

The look-up table is held in the array AV() and is filled by Reading the Data statements.

Element 129, corresponding to the character a which has display code 129, holds 161, the ASCII value for a. Where there are no Printable characters directly corresponding to what is Peeked, I have inserted the values of similar ASCII ones.

Lines 50280 and 50290, and 50320 and 50330 in part provide a border, while lines 50300 and 50310 enable both quotation marks and commas to be printed. It may not be as fast as machine code, but it is prettier and more flexible.

Hidden lines

At the end of the "Hidden Lines" on page 145 of the February issue it was suggested incorrectly that you Poke 49 into 15583. The correct location is 16583.

```
790 GETV2:IF(V2<1)+(V2>2)THEN790
800 POKE4466,10+2*V2:POKE4465,35:PRINT"+":USR(62):FORD=1TO1000:NEXT:RETURN
810 REM ITEM,DESCRIPTION,SOLID/LIQUID UNIT,PORTION,CARBO,PROT,FAT,ENERGY
820 REM   - ,     -   ,      -          ,  g  ,  g  ,  g  ,  g  , Cal
830 DATA APPLES,-,S,100,12,.3,0,46
840 DATA APRICOTS,CANNED,S,100,28,.5,0,106
850 DATA APRICOTS,DRIED,S,100,43,4.8,0,182
860 DATA BACON,-,S,100,0,11,48,476
870 DATA BEANS,BAKED,S,100,17,6,.4,92
880 DATA BEANS,BROAD,S,100,9.5,7.2,.5,69
890 DATA BEANS,HARICOT,S,100,46,21,0,256
900 DATA BEANS,RUNNER,S,100,2.9,1,1,0,15
910 DATA BEEF,CORNED,S,100,0,22,15,224
920 DATA BEEF,STEWING STEAK (COOKED),S,100,0,29,14,242
930 DATA BEEF,STEWING STEAK (RAW),S,100,0,17,16,212
940 DATA BEER,BITTER,L,100,2.3,.3,0,31
950 DATA BEER,MILD,L,100,1.6,.2,0,25
960 DATA COFFEE,INSTANT,S,10,3.6,.4,.07,16
970 DATA RICE,-,S,100,87,6.2,1,359
980 DATA RICE,PUDDING,S,100,16,3.6,7.6,142
990 DATA SAUSAGE,PORK,S,100,9.5,11,32,367
1000 DATA SAUSAGE,BEEF,S,100,12,9.6,24,299
2010 PRINT"■■■■┌──────────────────────────┐"
2020 PRINT"■■■■| FOOD VALUES - SHARP MZ-80K |"
2030 PRINT"■■■■|                          |"
2040 PRINT"■■■■|    FRANK ROONEY - OCT 83  |"
2050 PRINT"■■■■└──────────────────────────┘"
2060 RETURN
```

Screendump.

```
50000 REM SCREENDUMP by M.H. de Bokx (my version)
50010 REM P.O.Box524, 4380 AM Vlissingen, Nederland, dd 4/9/1983
50020 REM  C=Counter, DC=DisplayCode, HP=Horizontal Position
50030 REM SS=ScreenStart, PP=Peek/Poke Position
50040 REM ▒▒▒▒ CONVERSION DATA ▒▒▒▒
50050 PRINT "■PLEASE WAIT!"
50060 DIM AV(255):FOR DC=0 TO 255:READ AV(DC):NEXT DC
50070 REM ▒▒▒▒▒▒ DATA ▒▒▒▒▒▒
50080 DATA 128,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85
50090 DATA 86,87,88,89,90,251,205,221,203,209,48,49,50,51,52,53,54,55,56,57,45
50100 DATA 61,59,47,46,44,229,244,236,218,227,226,215,212,230,232,194,193
50110 DATA 196,199,207,202,128,225,254,200,250,95,248,241,247,63,204,219
50120 DATA 220,233,245,58,94,60,91,243,93,64,201,62,252,92,198,223,208
50130 DATA 206,211,210,255,33,34,35,36,37,38,39,40,41,43,42,222,246,235,234
50140 DATA 195,197,239,240,228,231,238,237,224,253,216,213,242,249,217,214
50150 DATA 192,161,154,159,156,146,170,151,152,166,175,169,184,179,176,183
50160 DATA 158,160,157,164,150,165,171,163,155,189,162,187,153,130,135,140
50170 DATA 188,167,172,145,147,148,149,180,181,182,174,173,186,178,185,168
50180 DATA 177,131,136,141,134,132,137,142,191,133,138,143,190,129,139,144
50190 DATA 127,252,94,198,95,72,67,96,97,98,99,100,101,102,103,104,112
50200 DATA 113,114,115,116,117,118,119,120,121,122,123,124,125,126,105,230
50210 DATA 232,218,227,35,35,35,106,107,108,109,62,110,111,253,112,128,221
50220 DATA 205,216,206,213,222,201,208,223,193,254,194,233,245,200
50230 PRINT "■";SPC(12);PRINT "■"
50240 REM ▒▒▒▒▒▒ TEST DISPLAY ▒▒▒▒▒▒
50250 PP=53648:FOR DC=0 TO 255:POKE PP+2*DC,DC:POKE PP+1,128:NEXT DC
50260 REM ▒▒▒▒▒▒ SCAN SCREEN & PRINT/P ▒▒▒▒▒▒
50270 SS=53248:HP=0:PRINT/P "■";:REM COMPRESS PRINT
50280 PRINT/P " ";:FOR C=0 TO 39:PRINT/P "_";:NEXT C:PRINT/P
50290 FOR PP=0 TO 40*25-1:IF HP=0 THEN PRINT/P " |";
50300 DC=PEEK(SS+PP):IF DC=98 THEN POKE 6350,0:PRINT/P CHR$(34);:POKE 6350,34
50310 IF DC=47 THEN PRINT/P ",";
50320 PRINT/P CHR$(AV(DC));:HP=HP+1:IF HP=40 THEN HP=0:PRINT/P "| "
50330 NEXT PP:PRINT/P " ";:FOR C=0 TO 39:PRINT/P "‾";:NEXT C:PRINT/P
50340 PRINT/P "■":REM 'CLEAR' PRINTER
50350 END
```

Subroutine calls

The article "Calling by Name" in the November 1983 issue of *Practical Computing* showed how calling sub-routines by name improves readability.

Normally Sharp Basic does not allow the use of numeric variables instead of line numbers, but it can do so if you modify the Goto and Gosub part of the interpreter to include a routine that converts an expression into an integer. For Goto

```
POKE 7388,140:POKE 7389,25
```

For Gosub Poke the same two values into locations 7415/6. The normal values held in these locations are 241,22.

A call which is normally made to a decimal-to-binary conversion routine at 5873 includes a check that the target line is an actual number. It is replaced without apparent damage by a call to the expression-conversion routine at 6540, which involves the interpretation of any numeric variables included in the expression. The routine places the calculated integral value into the same register that holds the result of a decimal/binary conversion. After the Return, the Goto or Gosub continues under the impression that it has found an actual number. ■

Subroutine calls.

```
100 REM 'FLASH' ANSWER SUBROUTINE
105 REM
110 REM To be used as a GOSUB following
120 REM a Y(es)/N(o)-type question like...
130 PRINT "Do you agree (Y/N)? ";
135 REM Here's the Routine
140 POKE 17828,0:USR(2483):GET K$
150 IF ((K$="Y")+1)*((K$="N")+1) THEN 140
160 RETURN
```

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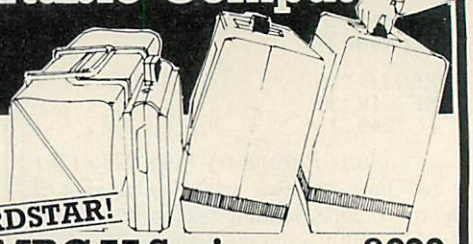

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White noise

SOME PEOPLE regard the ability of a computer to generate sound as a criterion in making up their mind which model to buy. The Spectrum's ability in this field is not great but Duncan Stokes of Cheltenham, Gloucestershire, believes that this routine will enhance the Spectrum by adding a white noise.

Once the program is typed in you can set the duration and frequency of the noise with Poke 32583,n and Poke 32589,n respectively; n is an integer between −255 and +255.

White noise.

```
10 CLEAR 32580
20 FOR F=32581 TO 32597
30 READ A:POKEF,A
40 NEXT F
50 DATA33,00,10,43,126,211,254,6,7,5,32,
   -3,175,132,200,24,-14
```

The routine is called by using the

RANDOMIZE USR 32581

function. To save the routine, which is advisable before running in case of incorrect data, you can use

SAVE"NAME" CODE 32581,16

Users of 48K machines can locate the routine higher up in memory.

Mazor

For those who like quick, bright graphics programs, Mr R D Lancaster has sent in the following item which will keep you busy

```
10 BRIGHT 1: BORDER 0: PAPER 0: INK 7:
   OVER 1:CLS
20 LET i=3
30 for f=51 to 10000 STEP 50
40 LET i=i+1
50 IF i=8 THEN LET i=4
60 INK i:CLS
70 PLOT 65,30
80 DRAW 120,120,PI*f
90 NEXT f
```

Mr Lancaster has also sent in a bright version of the popular maze game which he calls Mazor. It includes instructions, though one point is not mentioned: the border changes colour to that of the fastest ghost at the time.

Mazor.

```
  10 FLASH 0: INK 0: PAPER 7: BR
IGHT 1: BORDER 0: CLS
  100 LET q=.75: LET y=15: LET hi
=0: RESTORE : GO SUB 9000
  110 DIM b$(21,31)
  140 LET s=0: LET r=1: LET liv=5
  144 LET cc=0
  145 LET z=1: LET x=.5: LET t$="
■": FOR n=0 TO 5: BEEP .1,23: BE
EP .1,28: BEEP .1,20: NEXT n
  146 PRINT AT 0,0;"
          SCREEN=";r
  147 LET r=r+1: IF r=3 THEN LET
y=20
  148 IF r=4 THEN LET y=25
  149 IF r=5 THEN GO TO 2000
  150 LET b$(1)="■■■■■■■■■■■■■■■■
■■■■■■■■■■■■■■■
```

(continued from previous page)

```
 482 LET i=i-X*(i>p AND b$((i-X)
,U)<>"■")+X*(i<p AND b$((i+X),U)
<>"■")
 483 LET k=k-Z*(k>o AND b$(l,(k-
Z))<>"■")+Z*(k<o AND b$(l,(k+Z))
<>"■")
 485 LET t=t-q*(t>o AND b$(d,(t-
q))<>"■")+q*(t<o AND b$(d,(t+q))
<>"■")
 487 LET u=u-X*(u>o AND b$(i,(u-
X))<>"■")+X*(u<o AND b$(i,(u+X))
<>"■")
 490 PRINT AT p,o; INK 2;t$
 493 IF ATTR (l,k)=122 OR ATTR (
i,u)=122 OR ATTR (d,t)=122 THEN
LET liv=liv-1: FOR f=1 TO 15: BE
EP .01,0: BEEP .02,10: BEEP .04,
-10: NEXT f: FOR f=1 TO 8: BEEP
.1,-20: BEEP .1,-25: NEXT f: GO
TO 380
 495 PRINT AT i,u; INK 1;"■"
 497 PRINT AT d,t; INK 4;"■"
 500 PRINT AT l,k; INK 3;"■"
 510 IF ATTR (i,u)=123 THEN GO S
UB 1500
 520 IF b$(p,o)="·" THEN LET s=s
+2
 525 IF cc=21 THEN GO TO 144
 530 IF b$(p,o)="●" THEN LET s=s
+20: BEEP .1,40: LET cc=cc+1
 540 LET b$(p,o)=" "
 570 PRINT AT 0,17;s
 600 NEXT b
 700 GO TO 434
1000 FOR f=1 TO 30: BEEP .05,f:
BORDER 7: BEEP .05,f: BORDER 0:
NEXT f
1010 FOR f=1 TO 5: BEEP .1,10: B
EEP .1,0: BEEP .1,-10: BEEP .1,-
20: NEXT f
1015 BEEP .5,-30
1017 FLASH 0
1020 FOR f=1 TO 22
1022 LET a=USR 3280
1024 PAUSE 10: NEXT f
1030 PRINT AT 10,10; FLASH 1;"YO
U LOST"
1035 BEEP 3,-30
1036 PRINT AT 13,0;"Score : ";s
1037 PRINT AT 15,0;"Hi-score : "
;hi
1038 IF hi<s THEN LET hi=s
1040 PAUSE 100
1050 PRINT AT 20,1;"Another game
 ? (y/n)"
1060 IF INKEY$="" THEN GO TO 106
0
1070 IF INKEY$="y" THEN GO TO 11
0
1080 STOP
1500 LET j=INT (RND*18)+2
1510 LET h=INT (RND*28)+2
1520 IF b$(j,h)="■" THEN GO TO 1
500
1530 LET i=j: LET u=h
1540 RETURN
2000 PRINT AT 9,10; FLASH 1;"YOU
 WON !!"
2010 PRINT AT 11,10; FLASH 1;"YO
U WON !!"
2030 FOR f=1 TO 3: FOR n=1 TO 30
: BORDER 1: BEEP .01,20+n: BORDE
R 2: BEEP .01,25+n: BORDER 3: BE
EP .01,22+n: NEXT n: NEXT f
2040 BORDER 0: BEEP 1,50
2050 PRINT AT 20,1;"Another game
 ? (y/n)"
2060 IF INKEY$="" THEN GO TO 206
0
2070 IF INKEY$="y" THEN BEEP .3,
40: GO TO 105
2080 STOP
5000 PRINT #1; FLASH 1;"FREEZE"
5010 FOR f=0 TO 500: NEXT f
5020 PRINT AT p,o; INK 2;t$;AT i
,u; INK 1;"■";AT d,t; INK 4;"■";
AT l,k; INK 3;"■"
5030 INPUT "ENTER restarts ";q$
5035 PRINT AT p,o;" ";AT i,u;" "
;AT d,t;" ";AT l,k;" "
5040 RETURN
9000 FOR f=1 TO 7: READ a$
9010 FOR n=0 TO 7: READ a
9020 POKE USR a$+n,a
9030 NEXT n: NEXT f
9050 DATA "a",60,126,153,153,255
,219,102,60
9060 DATA "b",31,62,127,73,127,1
27,127,170
9070 DATA "c",0,0,0,24,24,0,0,0
9080 DATA "d",0,60,90,126,126,90
,60,0
9085 DATA "e",60,126,255,255,255
,255,126,60
9090 DATA "f",60,126,242,242,255
,252,98,62
9095 DATA "g",60,126,79,79,255,6
3,70,126
9100 PRINT AT 1,12;"MaZoR"
9110 PRINT AT 3,8; INK 2;"YOU : 
●"
9120 PRINT AT 5,6;"GHOSTS : ";AT
 7,1; INK 1;"■ (.5 or 1 times yo
ur speed)";AT 9,1; INK 3;"■ (.5
 or 1 times your speed)";AT 11,1;
 INK 4;"■ (.75 times your speed)
"
9130 PRINT AT 14,8;"· : 2 points
"
9140 PRINT AT 16,8;"● : 20 point
s"
9150 PRINT AT 19,7;"USE CURSOR K
EYS"
9160 PRINT AT 20,11;"TO MOVE"
9162 FOR f=15 TO 30: BEEP .1,50:
 BEEP .1,40: BEEP .1,25+f: NEXT
f
9165 PAUSE 400
9170 FOR f=0 TO 17: BEEP .4,60
9180 LET a=USR 3280
9190 NEXT f
9200 PRINT AT 5,2;"You must stee
r yourself until"
9210 PRINT AT 7,2;"you get all t
he ●'s when you"
9220 PRINT AT 9,2;"will be prese
nted with a new"
9230 PRINT AT 11,2;"screen."
9240 PRINT AT 13,2;"After 3 scre
ens you win."
9245 PRINT AT 15,2;"The screens
get harder!!"
9250 PRINT AT 17,2;"You have 5 l
ives."
9260 PRINT AT 20,2;"PRESS A KEY
TO PLAY"
9270 PAUSE 1000
9280 FOR f=0 TO 20: BEEP .005,60
9290 LET a=USR 3280
9300 NEXT f
9310 PRINT AT 3,2;"Press the spa
ce key to freeze";AT 4,2;"the ga
me. ENTER restarts."
9320 PRINT AT 8,5;"BEWARE the gh
osts can"
9330 PRINT AT 10,5;"use their sp
iritual"
9340 PRINT AT 12,5;"powers to tr
ansport"
9350 PRINT AT 14,5;"themselves t
o another"
9360 PRINT AT 16,5;"part of the
maze when"
9370 PRINT AT 18,5;"they unite !
"
9375 PAUSE 600
9380 CLS
9390 RETURN
```


● Circle No. 176 ▶

Tandy® TRS-80™: Setting The Standard

With Dot Matrix Printers...

9½" Dot-Matrix

£399

- With Colour Computer and Parallel Interfaces

DMP-120. This versatile 9½" dot-matrix printer has high speed data processing and graphics modes, that makes light work of many many tasks. It prints ten and 16.7 characters per inch, or elongated five and 8.3 characters per inch at up to 125 characters per second. A very compact printer it uses fanfold, single sheet or roll paper and has built in parallel and colour computer compatible serial interfaces. **26-1255**

Colour Graphics

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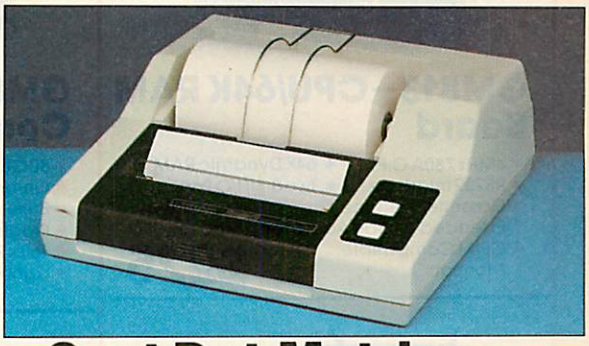
- Uses Easily Replaceable Ink Cartridges

CGP-115. Ultra-compact colour graphics printer helps you create beautiful graphics in red, green, blue and black, and it prints alphanumerics. Built-in commands make it easy! Text mode prints 40 or 80 characters per line at 12 characters per second. Uses easily replaceable ink cartridges. A selection of colour pens is available. Set measures 2 15/16 x 8 1/4 x 8 1/2". **26-1192**



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- Print Graphics and Alphanumerics
- Whisper Quiet!

TP-10 Thermal Printer. Perfect for use with the MC-10 Colour Microcomputer, and our other colour computers. You can print both screen graphics and alphanumerics. Textmode prints 32 characters per line at 30 characters per second on 4 1/8" wide thermal paper. Special repeat function to make graphics programming easier. Colour computer-compatible serial interface only (600 baud). **26-1261**

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...Or Choose The Daisy Wheel Printer To Meet Your Needs

"Letter Perfect"

£1199

With Free Bi-Directional Tractor Feed (26-1459)

DWP-410. Ideal for SCRIPSIT™ word processing! Select ten or 12 characters per inch, or proportional pitch. Forward and reverse paper feed and ½ line feed, underline and programmable backspace. Includes 1/120" space and 1/48" line feed. Automatic paper set makes paper insertion easy. Uses interchangeable print wheels for type selection. EPM mode for special wheels. **26-1250**

"Letter Quality"

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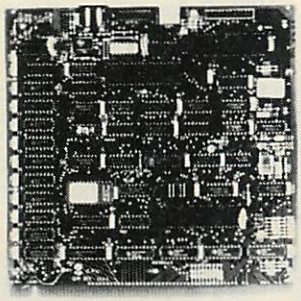
- With Automatic Wheel Positioning

DWP-210. A low-cost printer for that "professional look"! Select ten or 12 characters per inch, or proportional pitch. Prints over 200 words per minute (18 characters per second) at ten characters per inch. Easily handles an original plus two copies, features 1/200" space and 1/48" line feed, ribbon end, cover open and paper empty sensing. With carbon ribbon and Courier 10 print wheel. **26-1257**

MicroValue 80-BUS MULTIBOARDS



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* 64K Dynamic RAM
* RS232 Interface
* Two 8-Bit I/O Ports
* Cassette Interface
* Extended & Page Addressing Modes
* CP/M Compatible Monitor

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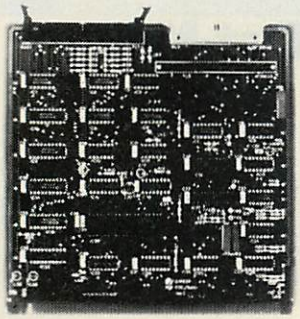

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* Supports 48 and 96 TPI Drives

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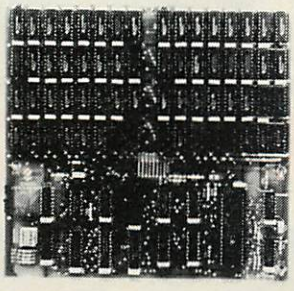

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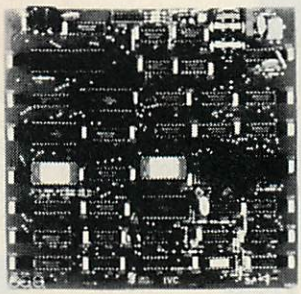

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* Programmable Character Generator
* 160×75 Pixel Graphics
* Light Pen Input

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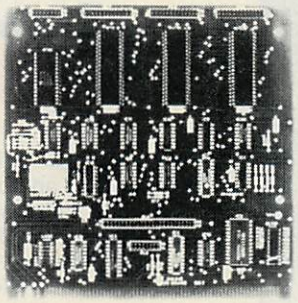

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* Cursor Control Keys

£85

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* Fibreglass P.C.B.
* 80-BUS Signal Identification
* High Density IC Capability

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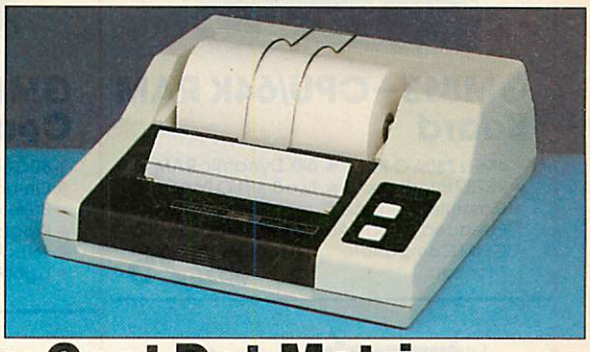

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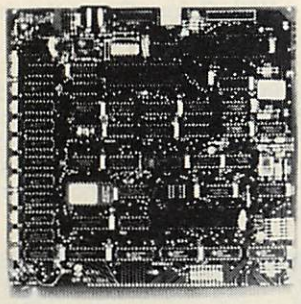
MicroValue 80-BUS MULTIBOARDS



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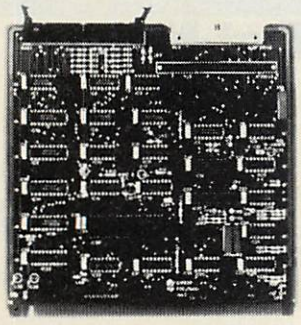

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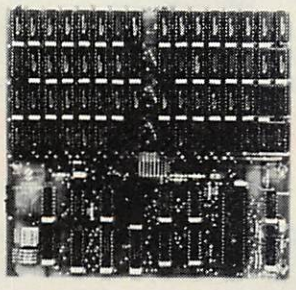

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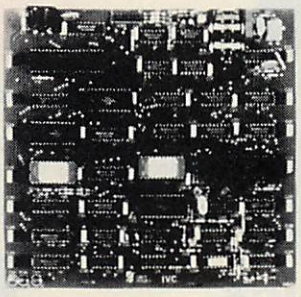

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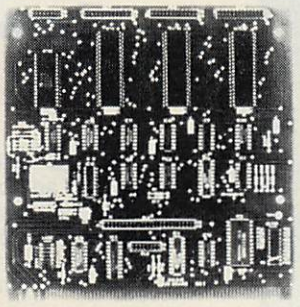

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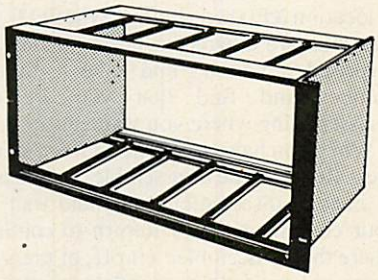

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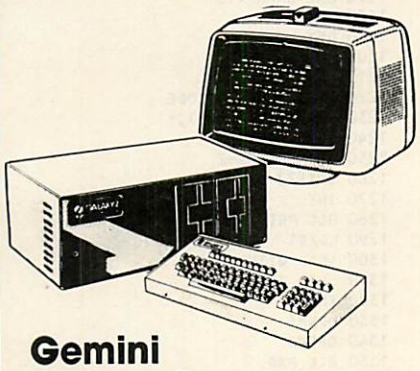

Gemini Galaxy 2

"I would place the Galaxy at the top of my list" (Computing Today, April 1983)

* Twin Z80A Processors
* CP/M 2.2 Operating System
* 80x25 Video Display
* 64K Dynamic Ram
* Light Pen Interface
* Up to 1.6Mhz Disk Capacity
* Serial RS232 Interface
* Parallel Interface
* Numeric Keypad
* Definable Function Keys
* Cassette Interface
* 12" Monitor Included

from £1495

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* 80-BUS Construction
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* Up To Three 5.25" Drives
* Fully Expandable
* Twin Z80A Processors
* CP/M Operating System
* 64K Dynamic Ram
* Definable Function Keys

Two-Drive Quantum £1910

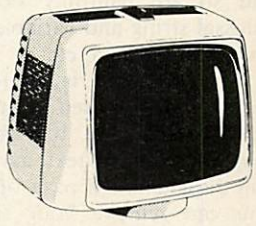
Gemini Multinet

The Gemini Multinet enables as many people as possible to have access to their own microcomputer with mass storage and printer facilities for the lowest possible cost. This is achieved by providing a central 'fileserver' fitted with a Winchester hard disk unit and printer interfaces, in conjunction with a method of interconnecting up to thirty-one workstations to the fileserver. The fileserver and each station are fitted with the Gemini GM836 network interface board. A Micropolis 800K floppy disk drive is incorporated in the fileserver providing backup for the hard disk.

GM910 Galaxy 4 Multinet 5.4 M/byte fileserver	£2600
GM912 Galaxy 4 Multinet 10.8 M/byte fileserver	£2850
GM909 Galaxy 4 Multinet workstation	£650

Both fileservers and workstations are supplied complete with VDU's; the operating software is suppliedwith the fileserver.

Phoenix P12 Monitor



A high quality 12" data display monitor, ideal for Gemini systems. The P12 is available in both green and amber phosphor versions and has a resolution of 20Mhz. **£95**

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Disassembler

ONE OF the major advantages of the BBC Micro is its built-in assembler. But there is a snag: once programs have been assembled, it is impossible to modify them without access to the original source code. If you have lost the source code, or if someone else wrote the program, you are in trouble.

Many disassemblers are written in Basic, and so are painfully slow and require colossal string and variable arrays to store op codes, bit data, etc.

Thus the stage is set for Disasm 2, a disassembler written entirely in machine code by C Dunne. It is around 600 bytes long, including all text, and is so fast that it will disassemble a page of 30 lines before you can remove your finger from the Return button. The only concessions it makes to simplicity are that all output is in hex, and that sometimes a garbage byte will happen to form part of a valid op code and produce a misleading destination address. Unrecognised bytes are designated Bug.

Type the program in as it stands and save it, but do not run it. Set Page to &2500 by:

PAGE = &2500

then load the program back in again. Run it this time and enter 1100 if you are a disc user; otherwise enter E00 as the assemble address. You can then type:

*SAVE DISSA 1100 +600

or

*SAVE DISSA E00 +600.

Any time you want to use the disassembler you now only need to load the assembled code, not the source, etc. You load the object code with:

*RUN DISSA

Operating the disassembler is a simple matter of entering four digits. If, for instance, you wished to start disassembling at location &E00 you have to type 0E00. All locations are entered in hex so do not be surprised if you try and enter a decimal number and find that you are not disassembling where you wanted too.

When you have typed the address, do not press Return. The disassembler will display 31 lines of disassembled text and wait for your command. Press Return to continue where the disassembler left off, or press the space bar to jump to another location to change the disassemble address.

```
  10 REM _____
_____
____
  20
  30 REM DISASM2:
                  THE Disassembler

                              Copyright
C Dunne 1982/83                 (Assis
ted by D Bainbridge)
  40 REM _____
_____
____
  50
  60 *TV0,1
  70 MODE4
  80 INPUT"ENTER LOAD ADDRESS (PREC
EDED BY '&' IF"'"IN HEXADECIMAL) :"D
$:DISASM%=EVAL(D$)
  90 INPUT'"DO YOU REQUIRE A LISTIN
G",D$
 100 IF LEFT$(D$,1)="N" D%=2:GOTO14
0 ELSE      IF LEFT$(D$,1)="Y" D%=3:
GOTO140 ELSE      PRINT"I BEG YOUR P
ARDON?":GOTO90
 110
 120 REM VARIABLE INITIALISATION
 130
 140 BTMSK=DISASM%+&180
 150 MOLEN=DISASM%+&1C4
 160 ALEFT=DISASM%+&1D1
 170 RIGHT=DISASM%+&1D7
 180 TEXTA=DISASM%+&1DE
 190 TEXTB=DISASM%+&21E
 200 OSWRCH=&FFEE
 210 OSNEWL=&FFE7
 220 OSRDCH=&FFE0
 230 OSBYTE=&FFF4
 240
 250 IF D%=3 VDU2:PRINT'"PROGRAM"'
 260 REM
              RELOCATABLE DISASSEMBL
ER SOURCE
                  _____
_____
 270
 280 FOR I%=0 TO D% STEP D%
 290 P%=DISASM%
 300 [OPT I%
 310
 320 LDA#229
 330 LDX#2
 340 LDY#0
 350 JSR OSBYTE
 360 \ESCAPE KEY GENERATES &1B
 370 .DISASM2 JSR OSNEWL
 380 JSR KBIP
 390 STA&76
 400 JSR KBIP
 410 STA&75
 420 \MAIN LOOP
 430 .DOLOOP JSR OSNEWL
 440 JSR D
 450 JSR D+7
 460 JSR OSNEWL
 470 JSR OSRDCH
 480 CMP#&D
 490 \KEY FOR NEXT BLOCK
 500 BEQ DOLOOP
 510 CMP#27
 520 \KEY TO EXIT TO BASIC=ESCAPE
 530 BNE DISASM2
 540 LDA#229
 550 LDX#0
 560 LDY#0
 570 JMP OSBYTE
 580 \RE-ENABLE ESCAPE
 590 RTS
 600 .D LDA#30
 610 \# OF LINES IN BLOCK =2 LESS T
HAN
 620 \# OF LINES IN PRESENT SCREEN
MODE
 630 STA&77
 640 JSR D+20
 650 JSR UPDATE
 660 STA&75
 670 STY&76
 680 DEC&77
 690 BMI D-1
 700 BNE D+4
 710 JSR PRTADDR
 720 LDA(&75,X)
 730 TAY
 740 LSR A
 750 BCC D+40
 760 LSR A
 770 BCS OPNT
 780 CMP#&22
 790 BEQ OPNT
 800 AND#7
 810 ORA#&80
 820 LSR A
 830 TAX
 840 LDA BTMSK,X
 850 \OPCODE BIT MASK TEST BYTE
 860 BCS KLM-8
 870 LSR A
 880 LSR A
 890 LSR A
 900 LSR A
 910 AND#&F
 920 BNE KLM
 930 \THAT WAS NO OPCODE (THAT WAS
MY WIFE!)
 940 .OPNT LDY#&80
 950 LDA#0
 960 \CALCULATE LENGTH & MODE
 970 .KLM TAX
 980 LDA MOLEN,X
 990 \ADDRESS MODE & LENGTH
1000 STA&71
1010 AND#3
1020 STA&72
1030 \GET COMPRESSED TEXT
1040 .SNARF TYA
1050 AND#&8F
1060 TAX
1070 TYA
1080 LDY#3
1090 CPX#&8A
1100 BEQ SNARF+22
1110 LSR A
1120 BCC SNARF+22
1130 LSR A
1140 LSR A
1150 ORA#&20
1160 DEY
1170 BNE SNARF+15
1180 INY
1190 DEY
1200 BNE SNARF+11
1210 PHA
1220 \PRINT HEX OPCODE
1230 .PRTOP LDA(&75),Y
1240 JSR PRTBYTE
1250 JSR SPACES-2
1260 CPY&72
1270 INY
1280 BCC PRTOP
1290 LDX#1
1300 \PAD WITH SPACES
1310 .PAD JSR SPACES
1320 INY
1330 LDX#3
1340 CPY#4
1350 BCC PAD
1360 PLA
1370 TAY
1380 LDA TEXTA,Y
1390 \FIRST HALF OF TEXT
1400 \(3 LETTERS=2 BYTES)
1410 STA&73
1420 LDA TEXTB,Y
1430 \SECOND HALF OF TEXT
1440 STA&74
1450 \CALCULATE MNEMONIC
1460 .KEKMNM LDA#0
1470 LDY#5
1480 ASL&74
1490 ROL&73
1500 ROL A
1510 DEY
1520 BNE KEKMNM+4
1530 ADC#&3F
1540 JSR OSWRCH
1550 DEX
1560 BNE KEKMNM
1570 JSR SPACES-2
1580 LDX#6
1590 \CALCULATE EXIT
1600 .KEXIT CPX#3
1610 BNE PRTMODE
```

```
1620 LDY&72
1630 BNE CHKBRA
1640 ASL&73
1650 BCC PRTMODE
1660 LDA#&41
1670 BNE SPACES+2
1680 \CHECK TO SEE IF BRANCH CALL
1690 \OR PRINT_MODE NEEDED
1700 .CHKBRA LDA&71
1710 CMP#&E8
1720 LDA(&75),Y
1730 BCS PRTBRA
1740 JSR PRTBYTE
1750 DEY
1760 BNE CHKBRA
1770 \PRINT ADDRESS MODE DETAILS
1780 .PRTMODE ASL&71
1790 BCC CHKBRA+32
1800 LDA ALEFT,X
1810 \OPEN ADDRESS MODE SYMBOL
1820 JSR OSWRCH
1830 LDA RIGHT,X
1840 \CLOSE ADDRESS MODE SYMBOL
1850 BEQ CHKBRA+32
1860 JSR OSWRCH
1870 DEX
1880 BNE KEXIT
1890 RTS
1900 \PRINT BRANCH ADDRESS
1910 .PRTBRA JSR UPDATE+3
1920 TAX
1930 INX
1940 BNE PRTBRA+8
1950 INY
1960 TYA
1970 JSR PRTBYTE
1980 TXA
1990 \PRINT HEX BYTE IN ACC
2000 .PRTBYTE PHA
2010 LSR A
2020 LSR A
2030 LSR A
2040 LSR A
2050 JSR PRTBYTE+9
2060 PLA
2070 AND#&F
2080 ORA#&30
2090 CMP#&3A
2100 BCC PRTBYTE+19
2110 ADC#6
2120 JMP OSWRCH
2130 \PRINT ADDRESS
2140 .PRTADDR JSR OSNEWL
2150 LDA&76
2160 LDX&75
2170 JSR PRTBRA+9
2180 \PRINT ONE SPACE
2190 LDX#1
2200 \PRINT (X) SPACES
2210 .SPACES LDA#&20
2220 JSR OSWRCH
2230 DEX
2240 BNE SPACES
2250 RTS
2260 \UPDATE POINTER ADDRESS
2270 .UPDATE LDA&72
2280 SEC
2290 LDY&76
2300 TAX
2310 BPL UPDATE+9
2320 DEY
2330 ADC&75
2340 BCC UPDATE+14
2350 INY
2360 RTS
2370 \GET ADDRESS FROM
2380 \USER VIA KEYBOARD
2390 .KBIP JSR KBIP+3
2400 JSR TESTKEY
2410 ASL A
2420 ASL A
2430 ASL A
2440 ASL A
2450 LDY#4
2460 ROL A
2470 ROL&70
2480 DEY
2490 BNE KBIP+12
2500 LDA&70
2510 RTS
2520 \ENSURE KEY IS VALID HEX
2530 .TESTKEY JSR OSRDCH
2540 JSR OSWRCH
2550 CMP#&30
2560 BMI TESTKEY+26
2570 CMP#&3A
2580 BCC TESTKEY+24
2590 CMP#&47
2600 BCS TESTKEY+26
2610 CMP#&41
2620 BCC TESTKEY+26
2630 SBC#7
2640 AND#&F
2650 RTS
2660
2670 ]
2680 NEXT
2690
2700 REM SET UP TEXT/OPCODE DATA
2710
2720 FOR X%=DISASM%+&180 TO DISASM%
+&25F STEP4
2730 READ!X%
2740 NEXT
2750
2760 REM DATA (MAINLY COMPRESSED TE
XT
2770 REM   AND OPCODES)
2780
2790 DATA&03450240,&094008D0,&33452
230,&094008D0,&33450240,&094008D0,&B
3450240,&094008D0,&33442200,&00448CD
0,&33442211,&9A448CD0,&33442210,&094
008D0,&33442210,&094008D0
2800
2810 DATA&A9781362,&82812100,&4D590
000,&4A869291,&292C9D85,&2628232C,&2
6580059,&8A1C0026,&8B5D231C,&8A9DA11
B,&8B9D231D,&291DA11D,&A869AE19,&532
42319,&5324231B,&1A00A119
2820
2830 DATA&69A55B5B,&AEAE2424,&0029A
DA8,&9C15007C,&69A59C6D,&13845329,&6
9A51134,&62D8A023,&6226485A,&4454889
4,&446854C8,&B49094E8,&B4748408,&F47
46E28,&F2724ACC,&AA008AA4
2840
2850 DATA&7474A2A2,&68447274,&00B23
2B2,&1B1B0022,&72722727,&CAC4C888,&4
4444826,&0000C8A2
2860
2870 IF D%=2 END
2880
2890 PRINT'"DATA"'
2900
2910 FOR X%=DISASM%+&180 TO DISASM%
+&25F STEP16
2920 PRINT;~X%;": ";
2930 FOR A%=0 TO 15
2940 PRINT;~A%?X%;" ";
2950 NEXT
2960 PRINT
2970 NEXT
2980 PRINT'"END"
2990 VDU3
3000
3010 REM ONCE THE PROGRAM IS TYPED
IN, SAVE IT ON TAPE FOR SAFETY. TO A
SSEMBLE       THE PROGRAM, SET PAGE
TO A VALUE SUCH THAT THE ASSEMBLED C
ODE WILL NOT          OVERWRITE THE
SOURCE CODE (BEAR IN MIND THAT IF YO
U DO NOT TYPE IN REMS,
3020 REM SPACES OR ASSEMBLER COMMEN
TS, WHICH ARE ONLY INCLUDED FOR EASE
 OF USE,      THE PROGRAM WILL RESID
E FROM PAGE TO PAGE+&1000 (INCLUDING
 VARIABLES) SO         THE LOWEST LOA
D ADDRESS WITHOUT RESETTING PAGE IS
&1E00 OR 7680 DECIMAL)
3030 REM AND *LOAD TO PAGE AND RUN.
 THE 'ADDRESS' PROMPT IS SELF-EXPLAN
ATORY,        THE 'LISTING' PROMPT R
EQUIRES 'Y' OR 'N' (NOTE THAT THIS R
EFERS TO HARD          COPY. IF YOU H
AVE NO PRINTER, ANSWER 'N' OR THE PR
OGRAM WILL APPEAR TO
3040 REM CRASH. IF YOU DO HAVE A PR
INTER, IT MUST BE INITIALISED, AND R
EADY FOR      A 'VDU 2' COMMAND TO E
NABLE IT).
3050 REM TO ENTER THE DISASSEMBLER,
 TYPE 'CALL DISASM%'. ENTER THE ADDR
ESS FROM      WHICH YOU WISH TO STAR
T DISASSEMBLING (BUT DO NOT PRESS RE
TURN). ONE PAGE       OF DISASSEMBLE
D CODE WILL APPEAR. TO CONTINUE TO T
HE NEXT PAGE HIT RETURN,
3060 REM TO END AND EXIT TO BASIC H
IT ESCAPE, OTHERWISE HIT ANY OTHER K
EY, THEN      TYPE IN THE NEW DISASS
EMBLY ADDRESS, WHEN A NEW PAGE OF DI
SASSEMBLED TEXT       WILL APPEAR.
```

Cassette box inserts

Of practical use to all cassette users is this program originally designed for an Epson MX-100 printer from Ian Masters of Thetford, Norfolk. The program will print out six cassette box labels or inserts per run.

One requirement is that you have a printer capable of printing 128 characters, uncondensed. Use 128-column by 11in. paper. Line 140 sets the line spacing to 1/6in. Line 150 sets the emphasised mode On.

Cassette box inserts.

```
  10 REM CASSETTE BOX INSERTS by Ian Ma
sters.  Sept 1983
  20 REM                    in BBC Ba
sic(Z80)
  30
  40 REM For use with MX100 Printer and
 128 column paper.
  50 REM The program will produce 6 cas
sette box inserts
  60 REM per sheet of 128 col by 11 inc
h paper.
  70 REM Don't be tight, use good paper
 80gsm+ and a good
  80 REM ribbon, for best results.
  90 REM Line 180 sets the line spacing
 to 1/6".
 100 REM Line 190 sets the emphasised m
ode ON.
 110
 120 A$ = STRING$(40,"_")
 130 B$ = STRING$(18,"_")
 140 C$ = STRING$(19,"_")
 150
 160 a% = &20002: REM          set the
print format.
 170  REM VDU2
 180 PRINT CHR$27;CHR$50
 190 PRINT CHR$27;CHR$69
 200 FOR Z = 1 TO 2
 210 PRINTA$;" ";A$;" ";A$
 220 FOR I = 1 TO 15
 230 PRINT I;B$;"|";C$;" ";
 240 PRINT I;B$;"|";C$;" ";
 250 PRINT I;B$;"|";C$
 260 NEXT I
 270 PRINT:PRINT
 280 PRINTA$;" ";A$;" ";A$
 290 FOR X = 16 TO 21
 300 PRINT X;B$;"|";C$;" ";
 310 PRINT X;B$;"|";C$;" ";
 320 PRINT X;B$;"|";C$
 330 NEXT X
 340 PRINT:PRINT
 350 NEXT Z
 360  REM VDU3
 370 END
```

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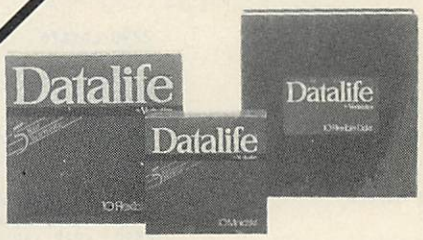

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Graphing

ALTHOUGH I GAVE you a graphing program in February I am including another now because it has a different approach. The first one merely read in a series of values and plotted them as x,y values whereas this one will allow the use to enter a mathematical function and plots the values of x against y. It will also allow points to be joined. This has been sent to me by M Jason Smith of Hemel Hempstead, Hertfordshire.

I would like to take Mr Smith to task over one point which is his commission of the unforgiveable sin of using I as a variable and he compounds his error by using it as a subscript in an array. If you wish to use I for your own programs which no one else has to look at that is fine but when a program has to be copied from a printout makes it more difficult and liable to error. error.

While in a correcting mood, I would also mention that I have had to reject a good game program because the author, who sent us a tape, used a separate line for every command, resulting in a long thin listing which would have taken a page to reproduce.

Sort routine.

```
10 CLEAR3000
20 DEFSTRA:DEFINTB-L,N-W,Z:DIM
G$(15),F1$(12),F1(12),F2$(13),F2(13),F3
(50),X1(20),Y1(20):J=0
30 CLS:QW=1:GOSUB450
40 =VARPTR(Z$):P=ABS(P):
L=PEEK(P+1)+256*PEEK(P+2):P=L+2
50 DATA=,213,+,205,-,206,*,207,/,208,
[,209,SGN,215,INT,216,ABS,217,SQR,221,
RND,222,LOG,223,EXP,224,COS,225,SIN,226
,TAN,227,ATN,228,RND,222,FIX,242
60 FOR I%=1TO6:READF1$(I%),
F1(I%):NEXT I%:FORI%=1TO13:READ
F2$(I%),F2(I%):NEXTI%
70 CLS:PRINT:PRINT:PRINT,"Graphing
Program":PRINT,"By Jason
Smith":PRINT:PRINT
80 PRINT,"F - Function (graph)"
90 PRINT,"P - Point"
100 PRINT,"C - Clear Axis"
110 PRINT,"S - Save Graph"
120 PRINT,"J - Join Points"
130 PRINT,"M - Menu"
140 PRINT,"X - Exit"
150 PRINT,"I - Instructions"
160 GOTO 210
170 CLS:A=" "+CHR$(129)+"
":PRINT@448,;
180 FORD=1TO12:PRINTA+"
";:NEXTD:PRINTA;:PRINT@31,;
190FORD=1TO15:PRINTCHR$(136)
+CHR$(24)+CHR$(26);:NEXTD
200 IFQW=1 THEN QW=0:RETURN
210 A$=INKEY$
220G1=G1+1:IFG1=5THENPRINT@0,
CHR$(140);
230 IFG1=10THENG1=0:PRINT@0," ";
240 IFA$=""THEN210
250 PRINT@0," ";:G1=0
260 IFA$="F"ORA$="f"THEN350
270IFA$="S"ORA$="s"THENQQ=1:
GOSUB590:GOTO210
280 IFA$="P"ORA$="p"THEN530
290 IF A$="I"ORA$="i"THEN890
300IFA$="C"ORA$="c"THENCLS:
QW=1:GOSUB170:GOTO210
310 IFA$="X"ORA$="x"THEN
POKEP+1,147:CLS:END
320 IFA$="J"ORA$="j"THEN 650
330 IFA$="M"ORA$="m"THEN 70
340 GOTO210
350 CLS
360 D$="":PRINT@0,"Function
";:PRINT@64,"";:INPUTF$:I3%=1:FOR
D=1TO LEN(F$):IFASC(MID$(F$,D,1))96
AND ASC(MID$(F$,D,1))123
THEND$=D$+CHR$(ASC(MID$(F$,D,1))-32):NE
XTD:ELSE D$=D$+MID$(F$,D,1):NEXTD
370 F$=D$
380 FOR I%=1 TOLEN(F$):FORI2%=1TO13:
IFMID$(F$,I%,3)=F2$(I2%) THEN
F3(I3%)=F2(I2%):I3%=I3%+1:I%=I%+2:NEXTI
%:ELSE NEXTI2%
390FORI1%=1TO6:IFMID$(F$,I%,1)
=F1$(I1%)THENIF3(I3%)=F1(I1%):I3%=I3%+1
: NEXTI%:ELSE NEXTI1%
400 F4%=ASC(MID$(F$,I%,1)):IFF4%)=35
AND F4%(=90 THEN F3(I3%)=F4%:I3%=I3%+1
410 NEXTI%
420 FORI%=1TOI3%-1:POKEP+I%,F3(I%):
NEXTI%:POKEP+I%,58: POKEP+1+I%,147
430IFQQ=1THENQQ=0:CLS:FORG=0TO15:
PRINTG$(G);:NEXTG:ELSEQW=1:GOSUB170
440 PRINT@0,"";:FOR X=-6TO6STEP 0.05
450 Z$="":REM=X*3:REM4:
REM.....
460 IFQW=1THENQW=0:RETURN
470 IF Y)70RY(-7THEN GOTO510
480 X1=10*X+62.5
490 Y1=-3*Y+22.5
500 SET(X1,Y1)
510 NEXTX
520 GOTO 210
530CLS:PRINT@0,"Point.";:
PRINT@64,"";:INPUT X,Y
540IFQQ=1THENQQ=0:CLS:FORG=0TO15:
PRINTG$(G);:NEXTG ELSE QW=1:GOSUB170
550 X1=10*X+62.5
560 Y1=-3*Y+22.5
570 SET(X1,Y1)
580 GOTO 210
590 G$=""
600FORI=0TO15:G=VARPTR(G$):POKEG,64:
POKEG+1,64*(I-INT(I/4)*4):POKEG+2,I/4
+60
610 IF I=15THEN G$=LEFT$(G$,63)
620 G$(I)=G$
630 NEXTI
640 RETURN
650 CLS
660 PRINT"Joining Points"
```

(continued on next page)

(continued from previous page)

```
670 PRINT:PRINT
680 INPUT"How many points";PO
690 FORP1=1TOPO
700 PRINTUSING"(ÆÆ) -
";P1;:INPUTX1(P1),Y1(P1)
710 NEXTP1
720
IF00=1THEN00=0:FORG=0TO15:PRINTG$(G);:N
EXTG ELSE 0W=1:GOSUB170
730 FOR P1=1TOPO
740 IF X1(P1)(-60RX1(P1))6THEN880
750 IF Y1(P1)(-70RY1(P1))7THEN880
760X1=10*X1(P1)+62.5:Y1=-3*Y1(P1)
+22.5
770 IFP1=PO THEN
X2=10*X1(1)+62.5:Y2=-3*Y1(1)+22.5:
GOTO790
780X2=10*X1(P1+1)+62.5:Y2=
-3*Y1(P1+1)+22.5
790 IFX2()X1THEN820
800 IFY1)Y2THENS=-1ELSES=1
810FORY=Y1TOY2STEPS:SET(X1,Y):
NEXTY:GOTO880
820 M=(Y2-Y1)/(X2-X1)
830 IFABS(M))1S=ABS(1/M)ELSES=1
840 IFX1)X2LETS=-S
850 FORX=X1TOX2STEPS
860 SET(X,M*(X-X1)+Y1)
870 NEXTX
880 NEXTP1:GOTO210
890CLS:PRINT"Instructions.":
PRINT:PRINT
900 PRINT"(F) : Enter a Function of
the form Y=X"
910 PRINT"      Commands allowed :-
+-=*/[ SGN INT ABS SQR RND"
920 PRINT"      LOG EXP COS SIN TAN
ATN RND FIX"
930 PRINT"      EG.  Y=2*X+5,
Y=SIN(X)/4,  Y=INT(X)+X[2"
940 PRINT"(P) : Plot a Point. Enter
(X,Y) Values."
950 PRINT"(J) : Join up Points.  Enter
the Number of Points wanted"
960 PRINT"      then enter the (X,Y)
values."
970 PRINT"(S) : Saves the Axis in an
array with all graphs and"
980 PRINT"      points plotted."
990 PRINT"(C) : Clears Axis of all
graphs and points."
1000 PRINT"(X) : Exit.  ALWAYS exit
program with this command."
1010 PRINT
1020 PRINT"Press (NEW LINE) to
Contine.";
1030 IFINKEY$=""THEN1030
1040 GOTO70
```

Reinforce.

Reinforce

Children start programing at an incredibly early age — the other day I heard of a boy of six writing games in Basic, though this may not be exceptional. The writer of the game Reinforce is of a fairly advanced age — 13 no less, almost past his prime. He is Stephen Daniels from Pinner in Middlesex. Instructions are included in the program, which is very neat for this type of game.

```
10 CLS:PRINT@19,CHR$(23)"RE-INFORCE":
PRINT@76,;"BY STEPHEN
DANIELS":PRINT@262,"DO YOU NEED
INSTRUCTIONS"
20 A$=INKEY$:IF A$="" THEN 20 ELSE IF
A$="Y" THEN GOSUB 200
30 CLS:A=RND(120):B=RND(17):
SET(A,B):FOR I=0 TO
127:SET(I,0):SET(I,47):NEXT I:FOR I=0
TO 47:SET (0,1):SET(127,I):NEXT I:FOR
I=53 TO 73:SET(I,18):SET(I,28):NEXT
I:FOR I=18 TO 28:SET
(53,I):SET(73,I):NEXT I
40 X=63:Y=23:XX=1:YY=1:ON ERROR GOTO
140
50 X1=X:Y1=Y:PRINT@120,V;:X=X+XX:IF
POINT(X,Y) THEN XX=-XX:RESET(X,Y):OUT
255,6:OUT 255,0::X=X1
60 Y=Y+YY:IF POINT (X,Y) THEN
YY=-YY:RESET (X,Y):OUT 255,6:OUT
255,0:Y=Y1
70 RESET (X1,Y1):SET(X,Y)
80 V=V+1:G=PEEK(14400)
90 A1=A:B1=B: IF G)128 THEN
G=G-128:L=1
100 IF G= 32 THEN A=A-1 ELSE IF G=64
THEN A=A+1
110 IF G=16 THEN B=B+1 ELSE IF G=8
THEN B=B-1
120 IF L=1 THEN L=0:RESET(A,B):GOTO 50
130 IF POINT(A,B) THEN A=A1:B=B1:GOTO
50 ELSE SET(A,B):GOTO 50
140 IF X (0 OR X)127  OR Y(0 OR Y)47
THEN RESUME 150 ELSE
A=A1:B=B1:SET(A,B):RESUME 50
150 LS:PRINT@19,"REINFORCE":PRINT@
272, "ESCAPED IN"V
160 IF V)W THEN W=V:PRINT@335,"BEST
SCORE YOURS"ELSE PRINT@335,"BEST
SCORE"W
170 PRINT@517,"PRESS ENTER FOR NEW
GAME"
180 A$=INKEY$:IF A$()CHR$(13) THEN 180
ELSE V=0:GOTO 10
200 CLS:PRINT"THE IDEA OF THE GAME IS
TO SEE HOW LONG YOU CAN KEEP THE
BOUNCING DOT FROM ESCAPING FROM THE
SCREEN. TO STOP THE DOT BUILD WALLS
WITH THE FOUR ARROW KEYS.  TO ERASE A
LINE WHEN YOU BOX YOURSELF IN, HOLD
DOWN THE SPACE BARWHILE YOU";
220 PRINT" MOVE":PRINT:PRINT"
   PRESS SPACE BAR TO START"
230 A$=INKEY$:IF A$=" " THEN RETURN
ELSE 230
```

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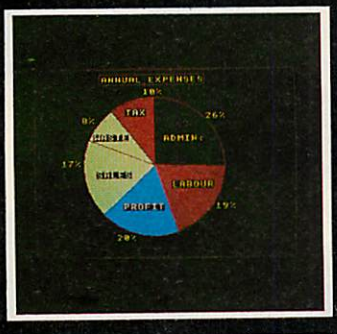

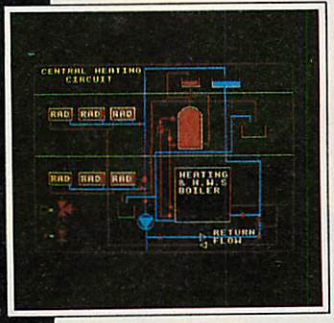

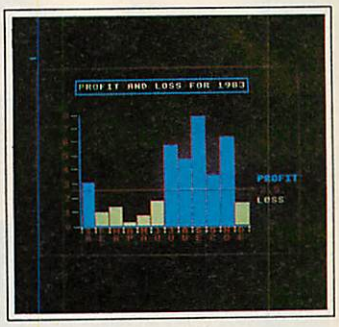

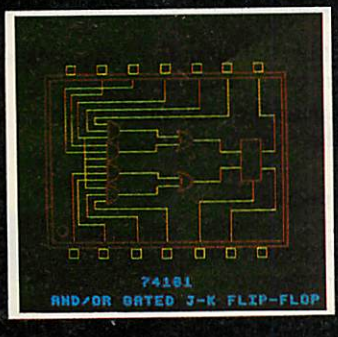

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Keyboard suppress

AN EARLIER Atari column included a sector-by-sector disc-copying program. In spite of the flippant headline — well, it was meant to be humorous — this was not a recipe for piracy. As was stressed at the time, the program would not, and was not intended to, copy protected commercial discs, but was for information only. However, it did raise a certain amount of interest in techniques for protecting programs.

In fact Atari programs are not easy to protect if you want to stop them from being copied. However, more likely you just want to prevent children from deliberately crashing programs, or perhaps stop people from reading your code — especially if your Basic looks as uncouth as mine.

With joystick-operated programs, the first obvious step is to disable the keyboard. It is very easy: just use

POKE 16,255

However, the the Break and System Reset keys still offer ways into the program.

Disabling the Break key is harder, because Print statements to the screen re-enable it, as do printing to the screen using Open and S: or E:. There is also the 6502's Interrupt Request to be disabled. The minimum you can try is

POKE 16,64:POKE 53774,64

You Poke both locations with 192 for a re-enable.

Then there is the System Reset key. Someone has published a routine in *Compute!*, June 1983, page 254, which effectively disables it. The program works by putting a Run statement on the screen when System Reset is pressed, then using Poke 842,12 to do a read from screen, and thus rerun the program. It is incredibly tedious.

A less friendly technique is simply to use Poke 580,1, known as Coldstart or, colloquially, The Plug. With any non-zero number in this location, pressing System Reset simply dumps the program. There is no automatic reboot.

More amusing is to change all the variables in the program. When you type in a variable name, the Atari puts it in a table. Each time the name is used after that, instead of remembering the name, Basic just remembers which position it occupies in the Variable Name table, VNT. This, of course, is how Basic allows long, meaningful variable names such as Totalsalaries without incurring an overhead in memory. It also means that once the program is finished you can change the names in the table.

The pointer to the start of the VNT is held in locations 130 and 131 decimal, while locations 132 and 133 hold the end. So it is a simple matter to Peek the start and end of the table, then Poke another character into each location in between. For example

```
FOR VNAME = PEEK(130) +
  PEEK(131)*256 TO PEEK(132) +
  PEEK(133)*256:POKE VNAME,155:NEXT
  VNAME
```

In this case, CHR$(155) has been chosen because it is the Return character, which makes the resulting listing pretty hard to follow. However, any character can be used instead, just by Poking in the ATASCII code.

If you have easier ways to protect Basic programs, please share details with the rest of us.

Before.

```
1 REM THIS PROGRAM REPLACES
2 REM THE VARIABLE NAMES
3 REM WITH CARRIAGE RETURNS
4 REM CHR$(155)
5 REM
10 JELLO=2
20 MORE=3
30 PRINT MORE*JELLO
40 FOR VNAME=PEEK(130)+PEEK(131)*256 TO
PEEK(132)+PEEK(133)*256
50 POKE VNAME,155
60 NEXT VNAME
```

After.

```
1 REM THIS PROGRAM REPLACES
2 REM THE VARIABLE NAMES
3 REM WITH CARRIAGE RETURNS
4 REM CHR$(155)
5 REM
10
=2
20
=3
30 PRINT
*

40 FOR
=PEEK(130)+PEEK(131)*256 TO PEEK(132)+PE
EK(133)*256
50 POKE
,155
60 NEXT

70 LIST
```

Blinking Atari.

```
99 REM *** DEMO PROGRAM ***
100 GOSUB 9000
200 LIST
900 END
8998 REM
8999 REM *** DEFINE 2 CHAR-SETS AND START BLINK ROUTINE ***
9000 RAMTOP=106
9020 MYTOP=PEEK(RAMTOP)-8:POKE RAMTOP,MYTOP
9030 GRAPHICS 0:? "WAIT";
9098 REM *** setup chset1 ***
9099 REM CHSET1 POINTS TO THE NORMAL CHAR-SET IN ROM AT PAGE 224
9100 CHSET1=224:CHMEM1=CHSET1*256
9118 REM *** setup chset2 ***
9119 REM CHSET2 POINTS TO A CHARSET WITH SPACES FOR LOWERCASE CHARS
9120 CHSET2=MYTOP:CHMEM2=CHSET2*256
9130 FOR I=0 TO 511:POKE CHMEM2+I,PEEK(57344+I):NEXT I
9140 FOR I=CHMEM2+512 TO CHMEM2+1023:POKE I,0:NEXT I
9299 REM *** page 6 charset blink routine ***
9300 FOR I=1540 TO 1606:READ J:POKE I,J:NEXT I:REM data 9500/9530
9310 POKE 1538,CHSET1:REM normal
9320 POKE 1539,CHSET2:REM includes spaces for lowercase chars etc
9330 POKE 1549,25:REM flash delay
9350 K=USR(1580):REM switch on the routine
9370 REM to switch the routine off either use K=USR(1596) or RESET
9400 RETURN
9500 DATA 206,0,6,173,0,6,208,29,169,20,141,0,6,238,1,6,173,1
9510 DATA 6,201,2,208,5,169,0,141,1,6,174,1,6,189,2,6,141,244
9520 DATA 2,76,98,228,104,169,0,141,1,6,162,6,160,4,169,7,32,92
9530 DATA 228,96,104,162,228,160,98,169,7,32,92,228,96
```

Blinking Atari

Nick Pearce of St. Leonards on Sea, East Sussex, points out that the Atari lacks a set of flashing characters, and he supplies a short machine-code routine to provide them. The machine code lives in page 6 of RAM, and is executed during the vertical blank period, VBlank, 50 times per second. It works by switching between two character sets at a rate controlled by a delay counter.

The demonstration program uses the normal character set in ROM, and one in RAM that has space characters instead of lower-case letters and graphics. This makes these characters flash.

After running the program, Nick suggests using Poke 1549,10 to increase the flash rate, and

POKE CHMEM2 + 135,255

to underline all the zeros. The results are very impressive. Once initiated, the routine will continue until disabled by

K = USR(1596)

or by pressing System Reset.

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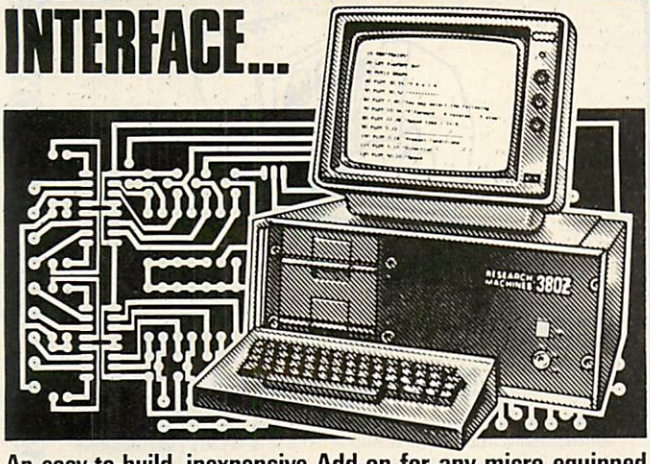

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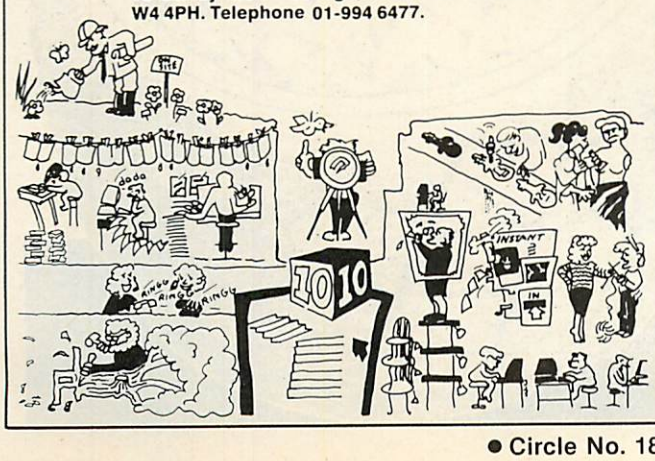

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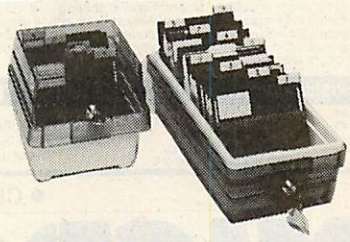

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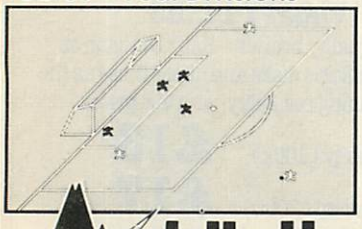

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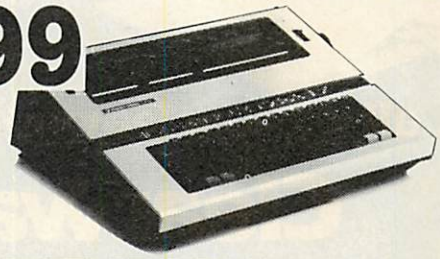

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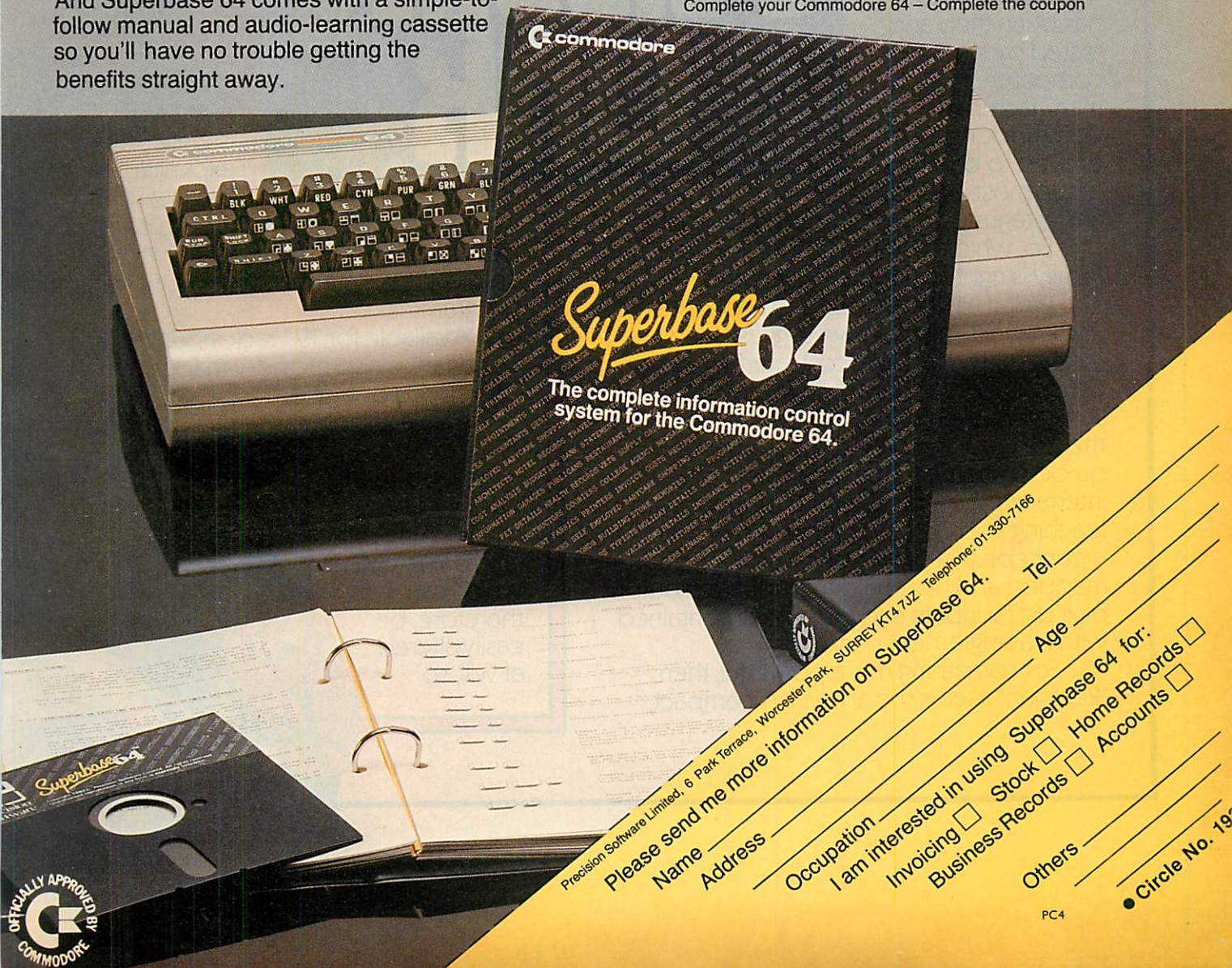

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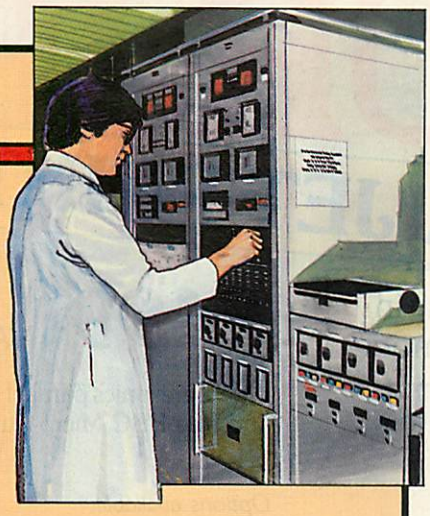

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>INTEGRATED SOFTWARE

First the Lisa and now the Macintosh, Lotus 1-2-3, Visi On and The Incredible Jack: these days much of the excitement in computing is generated by integrated software. In the Special Section inside the May issue, *Practical Computing* will be looking at the state of the art in integrated software development, and asking fundamental questions like: What is it? How worthwhile is it? What is really available?

>REVIEWS

Hewlett-Packard gear has always sold well to scientists, engineers and other sophisticated users, but now HP has produced a machine for everyday office use. The HP Series 100 Model 150 may not have a mouse, but it does have a touch screen for ease of use. We check it out. In software, the major development at the moment is the arrival of long-awaited versions of Logo. We hope to report on the implementations for Atari, Commodore, Research Machines and the Sinclair Spectrum.

>HOME INTO BUSINESS

Many small micros tout their potential for serious work, particularly if there is a route to CP/M. We will be surveying the field, and reporting on the arrival — or non-arrival — of Z-80 second processors for machines like the Acorn BBC Model B, Atari and Commodore 64.

>AND MUCH MORE

Chris Naylor will be telling you all you ever wanted to know about power supplies, but were afraid to ask, and reviews of the latest Spectrum games and BBC books. Plus there will be the usual round-up of news, views and programming tips, not to mention all that free software in Open File.

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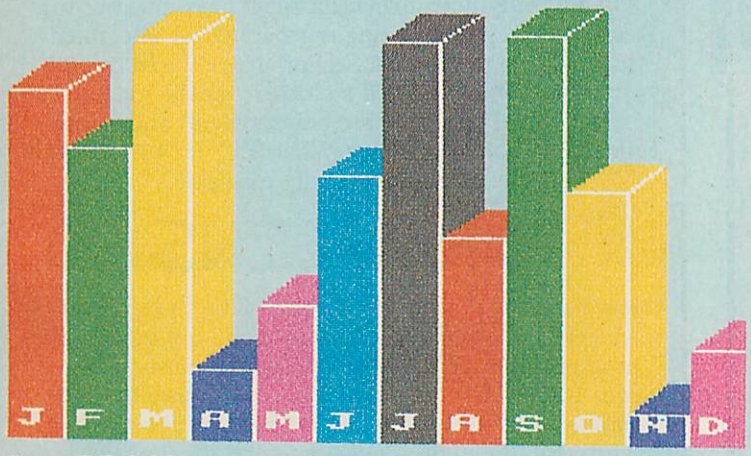

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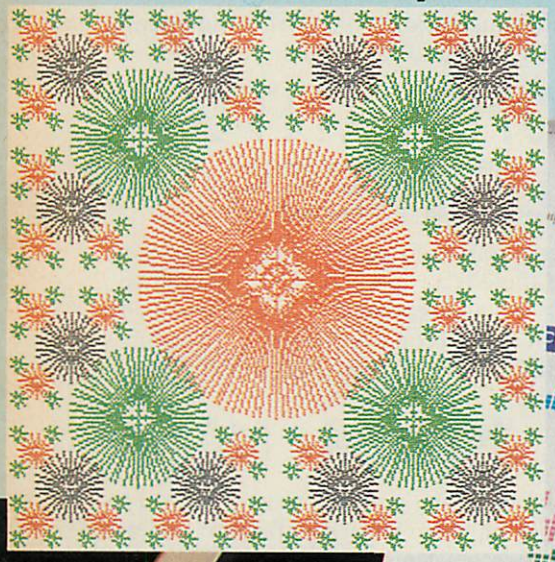

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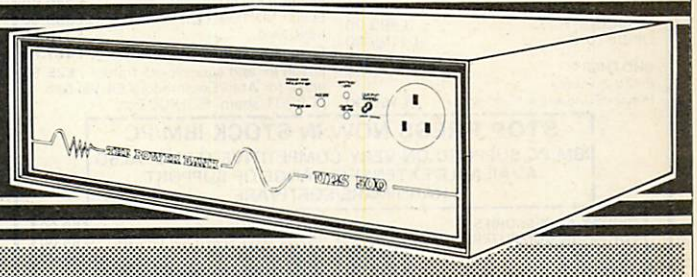

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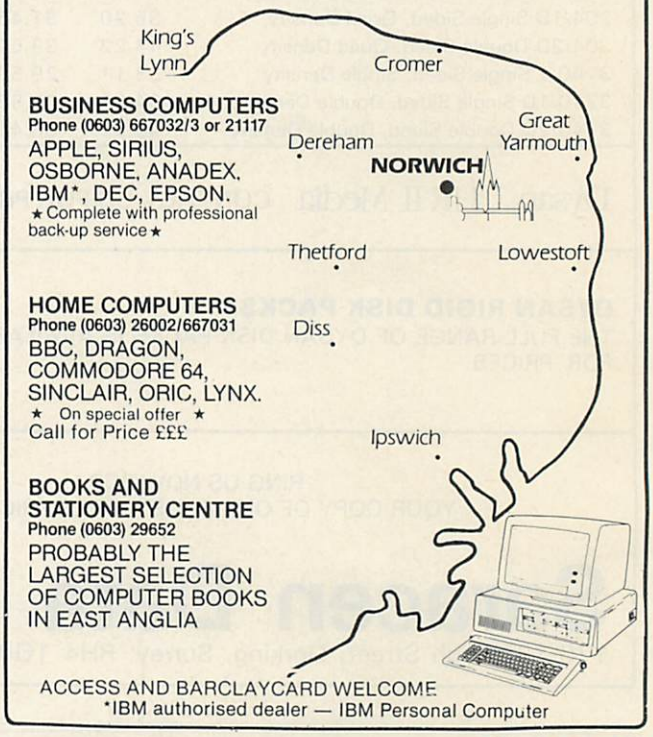

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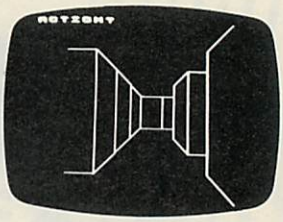

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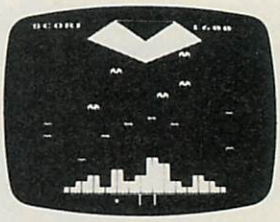

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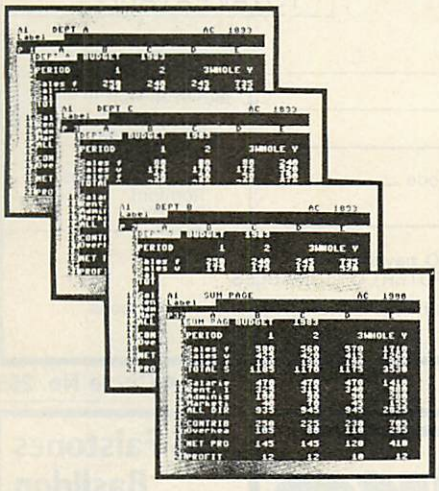

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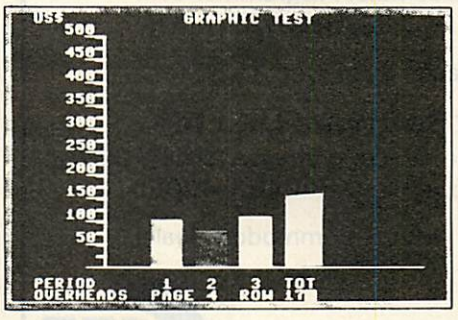

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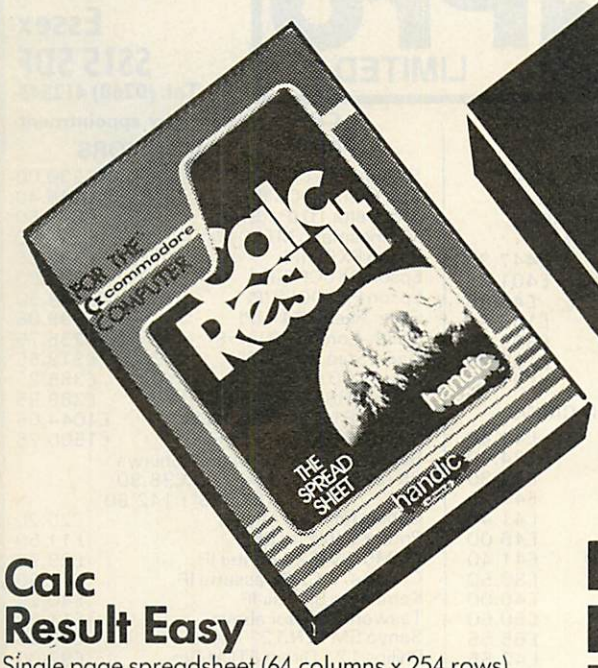

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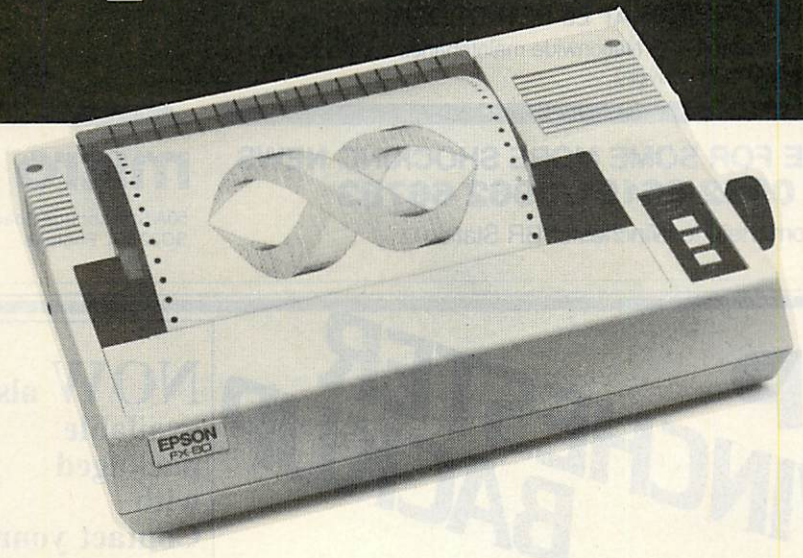

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DOMSDOS

In a special report we reveal the story behind the operating system of the eighties, suitable for all known domestic micros.

MANY HOME-MICRO owners have longed for an operating system like CP/M. Now it's here in a form that will run on virtually any machine — in Basic.

One day, at the beginning of 1984, when the winter snows still sat hard in their icy grip on the rolling terrain of northern Alaska, and apparently wiser people sat snug by their fires drinking warm punch and feeling the pleasant heat soak into their chilled bones, three men were climbing a mountain.

But they were not climbing it just because it was there. These were men with a mission. Arnold Headcrash, Arnold Byteswapper and Arnold Brownout had taken their ball-point pens and a tally roll of 4.5in. listing paper for a purpose. "We wanted to write an operating system that would genuinely be the operating system of the eighties. It had to be portable. It had to be transparent. It had to be concurrent. It had to be multi-tasking. It had to be user-friendly. It had to have easily modifiable error-messages . . ."

Round the bend

"And," interjected Headcrash, who faced the mammoth task of documenting the system, "it had to be written in British Intelligent Riting-Oriented Language — Biro-L." The rest is, as they say, history. All that remained was to get the coding done, and the product could be launched in an avalanche of publicity.

Here the intrepid trio had another brainstorm. Instead of releasing the new program on disc and getting users to do the final debugging, they would publish the entire source code in a leading computer magazine. The readers would then do the debugging and perhaps even add enhancements before the commercial version was put on the market on April 1.

In fact, given only an Apple II version, they reasoned, it would be pretty simple for readers of a certain calibre to convert it to their own obscure micros, as only line 50 is really machine-specific — it clears the screen and returns the cursor to the top left-hand corner. Part of the deal was, of course, that all conversions immediately became the sole copyright of the three Arnolds.

The deal was quickly done. *PC* provided three blank American Express cards, 100 packets of crisps and a complete set of Stanley Matthews' Cup Final programmes, and the code was handed over for publication.

"Thinking up a name nearly drove us round the bend!" exclaimed Byteswapper. "You see, it had to say it was disc based: ask anyone who's ever tried to ram a cassette into a floppy-disc drive. So it was a DOS. But it had to be better than that, it had to be a Super-DOS, which is where we got the concept of S-DOS. And then it hit us. It had to be available for every domestic micro known to man. That's how we got it: DOMSDOS.

And now DOMSDOS is here. It is written in Basic for ease of transcription. It is genuinely portable, given a lightweight machine. It is concurrent inasmuch as it exists all at once. It is multi-tasking inasmuch as it carries out all tasks equally. It is user-friendly to the extent that it is possible to use it at all. It runs on all popular makes of micro. And, best of all, it is fully user-transparent: just about anybody could see through it if they tried.

```
10  RESTORE
20 W = 1:N = 0:I = W
30  DIM E$(100)
40  READ E$(I): IF E$(I) <  > "END" THEN :N = N + W:I = I + W: GOTO 40
50  HOME : VTAB 3
60  PRINT "      DOMSDOS"
70  PRINT "      VERSION 13"
80  PRINT "(C) COPYRIGHT STATE HATCHERIES, 1984"
90  PRINT : PRINT
100  REM  CCP ROUTINES
110  INPUT "A:>";A$
120  IF  RND (1) < .2 THEN : PRINT A$;"?": PRINT : GOTO 110
130  REM  ERGOT ROUTINES
140  IF S = Z THEN :S =  INT ( RND (W) * N + W)
150  PRINT : PRINT E$(S): PRINT
160  IF S > 0 THEN :S = S + W: IF  RND (W) * 2 < W THEN :S = Z
170  GOTO 100
180  DATA  CAN'T CONTINUE ERROR
190  DATA   FRANKLY CAN'T CONTINUE ERROR
200  DATA   CAN'T TAKE ANY MORE ERROR
210  DATA  BDOS ERR ON P
220  DATA  DISC DRIVE INOPERABLE
230  DATA  MAIN BUS FAILURE ERROR
240  DATA  ARE YOU SURE ?
250  DATA  I MEAN ARE YOU REALLY SURE ?
260  DATA  COMMAND NOT RECOGNISED
270  DATA  REBOOT AND RETRY
280  DATA  DIVISION BY ZERO ERROR
290  DATA  DIVISION BY ZERO ERROR AGAIN
300  DATA  PLEASE RECONSIDER...
310  DATA  PLEASE PLEASE RECONSIDER
320  DATA  PRESSING WRONG KEYS ERROR
330  DATA  FIRE ON MAIN BOARD ERROR
340  DATA   YOU CAN'T BE SERIOUS ! ERROR
350  DATA  TRY KEYING 'HELP'
360  DATA  KEY 'SYSGEN' TO RECOVER
370  DATA  ILLEGAL QUANTITY - CALL POLICE
380  DATA  OUT OF MEMORY
390  DATA  OUT OF SIGHT
400  DATA  OUT OF MIND
410  DATA  TOO MUCH !
420  DATA  TOO COMPLEX
430  DATA  MUCH TOO COMPLEX
440  DATA  NEXT WITHOUT FOR
450  DATA  FOR WITHOUT NEXT
460  DATA  FOR WITHOUT FOR
470  DATA  NEXT WITHOUT NEXT
480  DATA  GOTO UNDEFINED
490  DATA   GOTO JAIL DO NOT PASS GO DO NOT COLLECT $200
500  DATA  BAD SUBSCRIPT
510  DATA  NAUGHTY SUBSCRIPT
520  DATA  EVIL SUBSCRIPT
530  DATA  SYNTAX ERROR
540  DATA  SYNTAX CURRENTLY 15%
550  DATA  FILE LOCKED
560  DATA  FILE MISSING
570  DATA  FILE MISSING BELIEVED KILLED IN ACTION
580  DATA  LANGUAGE NOT AVAILABLE
590  DATA  LANGUAGE NOT PRINTABLE
600  DATA  UNSPEAKABLE ERROR
610  DATA  PROGRAM TOO LARGE
620  DATA  PROGRAM TOO SMALL
630  DATA  RANGE ERROR - AIM HIGHER
640  DATA  WRITE PROTECTED
650  DATA  REALLY WRITE PROTECTED
660  DATA  READ PROTECTED
670  DATA  READ AND WRITE PROTECTED
680  DATA   NOT WORTH READING AT ALL FRANKLY
690  DATA  END
```

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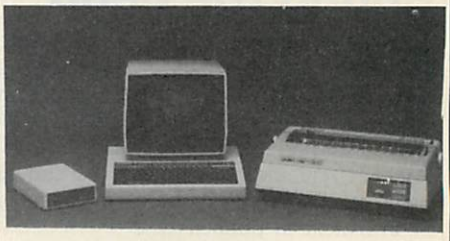

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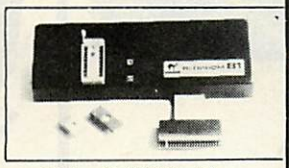

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EPROM TYPE —27128
RAM START ADDR —4000
EPROM ST. ADDR — 0000
JOB LENGTH — 4000
TASK — CHECK

WHICH TASK DO YOU WISH TO DO
W) CHECK THAT EPROM IS CLEAN
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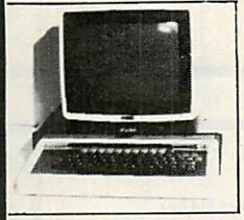

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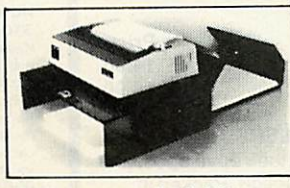

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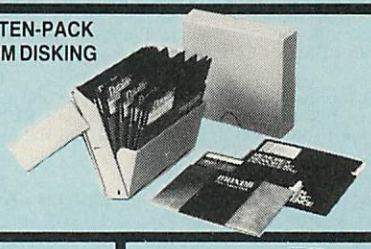

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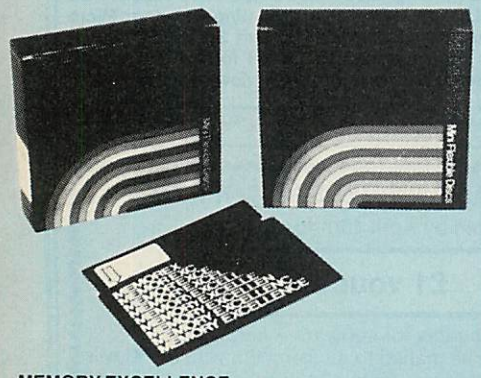

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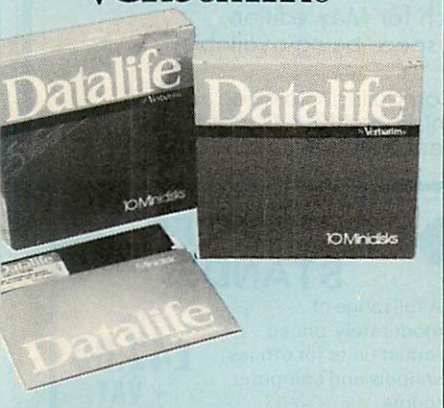

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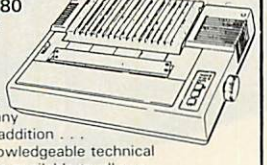

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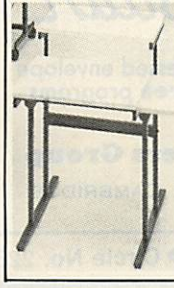

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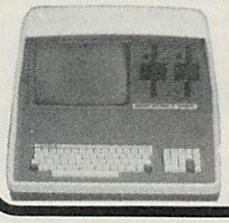

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